STIMULUS CONTROL OF

IMITATION IN CHILDREN

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ABSTRACT

Stimulus control of one-trial acquisition of novel imitations and continued emission of unreinforced imitations (generalised imitation) was investigated in four experiments. Five retarded 10 to 13 year old girls and a normal 5 year old boy served as subjects. Using differential reinforcement in a conditional discrimination paradigm, one retarded subject and the normal subject were successfully trained to imitate demonstrations of a set of training responses on S+ but not on S- training trials. New responses were successively introduced. Accelerated, and eventually one-trial, acquisition of novel imitations occurred only on S+ training trials. A probe set of responses was then demonstrated on interspersed S+ and S- probe trials. Unreinforced imitations occurred on S+ but not on S- probe trials. A discrimination reversal procedure was then conducted. Only S+ (previously S-) training trial imitations were reinforced. This procedure was repeated, after reversal of the training trials discrimination performance, at least once for each set of probe responses used. The normal subjects probe trial discrimination performance reversal was congruent with the training trials reversal through each of three reversals. Only a partial and temporary reversal of the probe trial discrimination performance occurred with the retarded subject. This weaker effect was replicated with two new sets of probe responses. It was concluded that one-trial acquisition of novel imitations and continued emission of unreinforced imitations, where it occurred, was discriminatively controlled

by the shared antecedent stimulus included in the contingency for reinforced imitations and that this was dependent on its inclusion in the contingency.

PREFACE

"Any behavior may be considered imitative if it temporally follows behavior demonstrated by someone else, called a model, and if its topography is functionally controlled by the topography of the model's behavior. Specifically, this control is such that an observer will note a close similarity between the topography of the model's behavior and that of the imitator. Furthermore, this similarity to the model's behavior will be characteristic of the imitator in responding to a wide variety of the model's behaviors". (Baer, Peterson, and Sherman, 1967, p.405).

"The term 'generalized imitation' refers to imitation of demonstrated behaviors that the subject has never been trained to perform and/or the continued performance of unreinforced imitative behaviors". (Martin, J., 1972, p.467).

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CHAPTER I

REVIEW OF THE LITERATURE

1.1 INTRODUCTION

Imitation has been an important concept in many child development theories. Often it has been used to "explain" other developmental phenomena but only in recent years has this been parallelled by empirical descriptions of the origins and organisation of imitative behaviour.

One research approach has involved brief exposure of subjects to preselected sequences of distinctive modelled behaviours and subsequent observation of subjects behaviour in situations containing materials used during modelling. Two dependent variables, range and frequency of delayed reproduction of modelled behaviours, have been studied in relation to independent variables including exposure to a model, sex of subjects and of models, the models response consequences, verbal instructions, incentives to imitate, the type of behaviour modelled and the type of relationship between subjects and the model.

Research of this type, reviewed elsewhere (Bandura, 1962, 1963, 1965b, 1969a, 1969b, 1971; Bandura and Walters, 1963; Flanders, 1968), has most often employed between group comparison designs with subjects who had previously acquired imitative repertoires. Hence there has been little concern about the origins of imitation or the implications an understanding of this might have in interpretation of experimental results.

Earlier research (Miller and Dollard, 1941) where large numbers of subjects were trained to perform a small number of apparently imitative behaviours, has had some influence on current conceptualisations of the origins of imitation. However their matched-dependent paradigm had limited implications for child development theories since, with the exception of their Experiment 9, they trained subjects to perform only one matching behaviour rather than a set of such behaviours. Bundura and Walters (1963) and Metz (1965) have argued that when the repertoire of matching behaviours is small, the mechanism need not be imitative since these might equally be occasioned by other arbitrarily chosen stimuli. Baer, Peterson, and Sherman (1967), Bayroff and Lard (1944), Peterson (1968b) and Skinner (1953) have also pointed out that behavioural similarity alone is not a sufficient condition for labelling behaviour as imitative.

Baer et al. (1967) suggested three sufficient conditions for describing behaviour as imitative, namely, that the behaviour temporally follows behaviour demonstrated by someone else, that its topography is functionally controlled by that of the demonstrated behaviour such that they are essentially similar, and that this behavioural similarity is characteristic for a wide range of demonstrated behaviours. Similar conceptualisations have been offered by Lovaas, Freitas, Nelson, and Whalen (1967) and Metz (1965). Recently imitations have been conceptualised as discriminative operants. Researchers taking this approach have used small numbers of subjects in single subject

research designs and have often investigated the acquisition and maintenance of imitation in relation to the general area of development and organisation of generative behavioural repertoires.

Since the demonstration by Baer and Sherman (1964) of reinforcement control of an imitative response class an increasing number of experimental analyses of imitation have been reported: e.g. Acker and Acker (1971) with normal children; Garcia, Baer, and Firestone (1971) with retarded children; Lovaas, Berberich, Perloff, and Schaeffer (1966) with schizophrenic children; and Sherman (1965) with mute adult psychotics. As well there have been reports and reviews of operant conditioning of imitation to produce socially and therapeutically significant behaviour changes (Baer, 1968; Blake and Moss, 1967; Hartung, 1970; Hewitt, 1965; Hingten, Coulter, and Churchill, 1967; Lovaas, 1966, 1968; Lovaas et al., 1966; Lovaas et al., 1967; Marshall and Hegrenes, 1970; Martin, M., 1976; Metz, 1965; Risley and Wolf, 1967; Sherman, 1965; Stark, Giddan, and Meisal, 1968; Sulzbacher and Costello, 1970; Whalen and Henker, 1971).

Researchers investigating the sufficient conditions for the establishment of imitation using non-imitative developmentally retarded subjects (Baer et al., 1967; Bry, 1970; Bry and Nawas, 1972; Lovaas et al., 1966; Martin, M., 1971; and Metz, 1965) found that all subjects acquired imitative repertoires when various combinations of positive reinforcement, physical guidance,

prompting and fading, and shaping procedures were used. Bry (1970) and Bry and Nawas (1972) found reinforcement to be a necessary condition with their subjects.

A consistent finding has been that as the number of topographically differing imitations in the repertoire is increased by training, acquisition of new imitations is accelerated and the likelihood of imitation of novel behaviours following their first demonstration is increased (Baer et al., 1967; Berkowitz, 1969; Bry and Nawas, 1972; Garcia et al., 1971; Lovaas et al., 1966; Lovaas et al., 1967; Peterson, 1966; Risley and Wolf, 1966, 1967; Sherman, 1965; Streifeland Phelan, 1972; Williams, 1971). A related finding was that new imitations may be acquired and maintained without experimenter arranged reinforcement when trials for unreinforced imitations (probe trials) were interspersed among trials for reinforced imitations (Baer et al., 1967; Berkowitz, 1969; Bufford, 1971; Garcia et al., 1971; Martin, J., 1971a; Metz, 1965; Peterson, 1966, 1968b; Risley, 1968b; Williams, 1971). Similar, though less consistent results have been obtained using normal and developmentally retarded children who had previously acquired imitative repertoires (Acker and Acker, 1971; Baer and Sherman, 1964; Bandura and Barab, 1971; Brigham and Sherman, 1968; Burgess, Burgess, and Esveldt, 1970; Peterson and Whitehurst, 1971; Peterson, Merwin, Moyer, and Whitehurst, 1971; Steinman, 1970a, 1970b; Steinman and Boyce, 1971; Waxler and Yarrow, 1970), though one study found almost no maintenance

of unreinforced imitations when only two different imitations were reinforced (Parton, 1970). This acquisition and maintenance of unreinforced imitations has become commonly referred to as generalised imitation.

More recently the research focus has shifted to analysis of conditions controlling acquisition and maintenance of so called "generalised imitation". In several studies the frequency of reinforced and unreinforced imitations declined together when extinction or differential reinforcement of other behaviour (DRO) operations were applied to previously reinforced imitations, and recovered together when reinforcement was reinstated (Baer and Sherman, 1964; Baer et al., 1967; Berkowitz, 1969; Bufford, 1971; Peterson, 1966; Waxler and Yarrow, 1970). Brigham and Sherman (1968) found the same relationship between frequency of reinforced verbal imitations and accurary of unreinforced verbal imitations using DRO. This covariation in frequency (or accuracy) of reinforced and unreinforced imitations has suggested conceptualisation of these as members of a common functional response class.

However, some researchers have not obtained generalised imitation with some subjects (Baer and Sherman, 1964; Bandura and Barab, 1971; Burgess et al., 1970; and Parton, 1970) or, obtained generalised imitation but were unable to demonstrate reinforcement control with some subjects (Burgess et al., 1970; Peterson and Whitehurst, 1971; Steinman, 1970a; Steinman and Boyce, 1971) or under some conditions (Martin, J., 1972).

1.2 THEORETICAL ACCOUNTS OF GENERALISED IMITATION

Three major accounts of general imitation have been offerred. These are:

(1) the conditioned reinforcement theory (Baer, 1968; Baer and Sherman, 1964; Baer et al., 1967; Lovaas et al., 1966; Peterson, 1968a; Staats, 1968);

(2) the discrimination difficulty theory (Bandura 1969a, 1969b; Bandura and Barab, 1971) and a variant of this, the reinforcement scheduling theory (Gewirtz, 1969, 1971; Gewirtz and Stingle, 1968);

(3) stimulus control theories (Bufford, 1971; Burgess et al., 1970; Martin, J., 1971a, 1971b, 1972; Peterson and Whitehurst, 1971; Peterson et al., 1971; Steinman, 1970a, 1970b; Steinman and Boyce, 1971; Williams, 1971).

1.2.1 The Conditioned Reinforcement Theory

The conditioned reinforcement theory is that behavioural similarity to a model is a stimulus property which through a history of temporal pairing with experimenter arranged reinforcement becomes discriminative for reinforcement, and hence acquires conditioned reinforcing properties (Baer et al., 1967) or symbolic reward value (Lovaas et al., 1966).

This may be criticised on logical grounds. The conditioned reinforcer effect has not been directly demonstrated and has only inferential status dependent on the generalised imitation effect it is used to explain. Also, Baer, et al., (1967) have not diffentiated

between acquisition and maintenance of unreinforced imitations. The first emission of a new imitation cannot logically be explained in terms of consequent events (conditioned reinforcement), since these cannot influence the prior probability of a response through reinforcement effects alone.

The strongest evidence supporting a conditioned reinforcement account of the maintenance of unreinforced imitations was reported by Lovaas, et al., (1966) and Brigham and Sherman (1968). These authors exposed American children to modelled Norwegian and Russian words interspersed among trials where English words were modelled and imitations were reinforced. Though imitations of novel words were never reinforced the accuracy of pronunciation increased. Brigham and Sherman showed by functional analysis that pronunciation accuracy of imitations of novel Russian words was controlled by reinforcement contingent on imitations of English words.

However Peterson (1966, 1968b) found that imitative class membership was not crucial for maintenance of unreinforced responses. He interspersed trials for previously trained non-imitative responses among trials for reinforced imitations. Though the unreinforced non-imitative responses did not produce behavioural similarity to the model, they were shown to belong to the same functional class as the reinforced imitations. Their performance was controlled by reinforcement contingencies applied to imitations. Martin, J., (1971b) also found that behavioural similarity to the model was not an

essential response consequence for maintenance of unreinforced responses. Trials for verbal instruction cued unreinforced responses were interspersed among trials for reinforced imitations. Reinforcement control of both sets of responses was demonstrated in a functional analysis using DRO schedules for the previously reinforced imitations.

Bandura and Barab (1971) have pointed out that the conditioned reinforcement theory predicts that continued pairing of behavioural similarity to the model with arranged reinforcement of one set of imitations would maintain or strengthen the conditioned reinforcing properties of behavioural similarity. However they found that performance of unreinforced imitations declined with increasing sessions though reinforced imitations were maintained.

In summary, the conditioned reinforcement account of acquisition of novel imitations may be questioned on logical grounds, and empirical data does not support the conditioned reinforcement interpretation of the maintenance of unreinforced imitations.

1.2.2 The Discrimination Difficulty Theory.

Bandura (1969a) argues that:

> When a few nonrewarded, modeled responses are randomly distributed in a large number that are consistently reinforced, the two sets of responses cannot easily be distinguished and are therefore likely to be performed with similar frequency. If ... the discriminative complexity of the modeling task were reduced ... the observer would eventually recognize that the latter [probe] responses never produce positive

> outcomes and he would, in all likelihood, stop reproducing them .... a discrimination hypothesis would predict that the longer the differential reinforcement practices are continued, the more likely the observer is to distinguish between rewarded and unrewarded imitative behaviors, with resulting rapid decline of unrewarded imitative responses. (p.127).

This argument has been repeated with near identical wording in other articles (Bandura, 1969b, p.236; Bandura and Barab, 1971, p.245).

His essential argument is that at the time when generalised imitation is demonstrated, subjects not only do not, but cannot, differentially respond on the basis of the different stimulus topographies of response demonstrations used on trials for reinforced and unreinforced imitation. He argues that this explains generalised imitation. Gewirtz (Gewirtz 1969, 1971; Gewirtz and Stingle, 1968) conceptualises reinforced and unreinforced imitations as topographically diverse members of a common functional response class acquired and maintained through intermittent reinforcement of members of the class. Intermittent reinforcement is emphasised as contributing to discrimination difficulty.

This theory has been criticised on logical grounds by Steinman (1970a) who states that "attributing the nondifferential imitation that occurs when generalized imitation procedures are used to discrimination difficulties is unwarranted when the only evidence is the fact that the child is imitating nondifferentially". (p.81).

Nevertheless some of the studies where the conditions would be expected to facilitate differential

imitation provide evidence from which one can infer support for the theory. One such condition is the use of probe responses (for unreinforced imitations) of distinctively different topographies from the training responses (for reinforced imitations). Baer et al., (1967) established generalised motor imitation with retarded subjects and then probed their repertoires using verbal responses and found that neither of two subjects produced verbal imitations without additional training. Garcia et al., (1971) used four retarded subjects and provided sequential training for "small motor", "large motor", and "short verbal" imitations. The developing repertoire was probed before, during and after training of each new category of imitation topography. Generalised imitation was observed in all subjects but was restricted to the categories of imitation topography which had been or were being trained. Acker and Acker (1971) found with four normal children, that following training to imitate "neutral" behaviours (simple body movements) generalised imitation was obtained with "neutral" probe responses but was less so with "affectionate" and "aggressive" probe responses. Bandura and Barab (1971) trained nine normal children to imitate motor responses, then probed the repertoire with responses of similar (motor) and dissimilar (vocal) topographies. Generalised imitation was only obtained with the similar response topographies. Different results were obtained by Steinman and Boyce, (1971). They trained four normal children to imitate a variety of hand movements, then probed the repertoire with a variety of

"hand" "foot" and "verbal" responses. No significant imitation frequency differences were found between similar (hand) and dissimilar (foot and verbal) probe responses. Generally however, where probe responses distinctively differ from training response topographies, generalised imitation is less likely to occur, which is consistent with the discrimination difficulty theory.

Differential performance of reinforced imitations might also be expected to be facilitated where smaller numbers of different response topographies are used. Peterson et al., (1971) reported an experiment involving only two reinforced and two unreinforced imitations in some phases. Three of four normal subjects did not show generalised imitation when the model left the room following each response demonstrations but unreinforced imitations were maintained for all subjects when the model remained in the room. Though subjects clearly "discriminated" between reinforced and unreinforced responses they nevertheless emitted unreinforced imitations during the model present condition. In a later phase the presumed complexity of the discrimination was increased by increasing the number of reinforced and unreinforced imitations. This manipulation produced no increase in generalised imitation for more than three or four sessions in the model absent condition. Bufford (1971) systematically reduced the number of different reinforced verbal imitations from 10 to one, while retaining a constant number of different unreinforced imitations and constant number of trials per session. He concluded that "The effects [on

maintained emission of unreinforced imitations] of systematic reduction of the number of words in the reinforced class were ... not particularly strong". (p.42). Hence in terms of the number of different response topographies index of discrimination difficulty, the evidence does not support this account of generalised imitation.

Bandura (Bandura 1969a, 1969b; Bandura and Barab, 1971) states that continued differential reinforcement should lead to a decreased frequency of emission reinforced imitations. Bandura and Barab (1971) and Parton (1970) have reported declines in generalised imitation correlated with increasing numbers of differential reinforcement sessions. However, Peterson et al., (1971) found no decrease in generalised imitation related to the number of differential reinforcement sessions. Similarly, Baer et al., (1967) found no decrease in emission of probe trial imitations with three retarded subjects even after a number of differential reinforcement sessions considerably larger than those reported in most similar studies. Prolonged differential reinforcement does not necessarily produce a decline in generalised imitation. Where such declines do occur this does not necessarily imply subjects were not capable of differential response prior to the decline. The evidence here provides no real support for the discrimination difficulty theory.

Another approach to reduction of discrimination difficulty has involved presentation of trials for unreinforced imitations in blocks rather than interspersed

among trials for reinforced imitations. Bandura and Barab (1971) found that unreinforced imitation of verbal responses presented in blocks declined while unreinforced imitation of motor responses presented on interspersed trials did not. Burgess et al., (1970) using three mildly retarded 11 to 14 year olds, ran trials for reinforced English word imitations and unreinforced Spanish word imitations in clearly separated blocks. Two of three subjects continued to imitate Spanish words over 22 sessions. After a one session observation of the third subject, who did not imitate Spanish words, their Spanish word imitation decreased to zero in the following session. This rapid change suggests that block trials presentation may have facilitated "discrimination" of response differences, but nevertheless Spanish word imitation continued prior to the observation session. Peterson (1966, 1968b) extinguished imitations of a small number of responses to a criterion of no imitation over 10 consecutive trials, using a massed presentation procedure. Further trials for the extinguished, and still unreinforced, imitation were then interspersed among trials for reinforced imitations. In a functional analysis the massed presentation extinction procedure was alternated with the interspersed trials procedure three times for each of six different unreinforced imitations. Unreinforced imitations occurred on 60 to 100 per cent of interspersed trials. It seems tenuous to argue that maintained emission of unreinforced imitations on the interspersed trials was a result of discrimination difficulty.

The strongest evidence against the discrimination difficulty theory comes from research using concurrent or sequential control procedures which enable evaluation of the subjects ability to discriminate between trials for reinforced and unreinforced imitations at the time when generalised is being demonstrated. Steinman (1970a, 1970b) and Steinman and Boyce (1971) reported that children emitted unreinforced imitations when no reinforced alternative was available, but reliably emitted reinforced imitations when trials for these were presented either immediately before or after those for unreinforced imitations in a choice procedure. Single and choice presentations were made within the same sessions using the same sets of response demonstrations. Hence the generalised imitation could not be explained in terms of subjects inability to distinguish between reinforced and unreinforced response topographies. Bufford (1971) and Steinman (1970a, 1970b) found that generalised imitation was reduced when subjects were instructed not to perform unreinforced imitations, and recovered when "Don't care if you do unreinforced imitations or not" instructions were given. In addition, Steinman (1970a) ran recognition trials where subjects were asked to identify modelled responses as members of the reinforced or unreinforced sets. The subjects, who had all displayed generalised imitation, correctly identified 82% of the responses. These results show that discrimination difficulty cannot be a necessary condition for generalised imitation.

In conclusion, the discrimination difficulty theory

does not include any explanation of the acquisition of new imitations and its explanation of maintained unreinforced imitations is tautologous. In addition, any strong statement of the theory, namely that generalised imitation occurs because of subjects inability to discriminate between reinforced and unreinforced response topographies is not empirically supported. However there remains a possible reformulation in terms of an empirically based descriptive statement to the effect that under single presentation trial conditions the probability of emission of reinforced and unreinforced imitations is not reliably controlled by the differential reinforcement contingency or by the different stimulus configurations of the response demonstrations which occasion reinforced and unreinforced imitations. This would eliminate the tautology in Bandura's theory and might lead to asking questions such as "What stimuli do control members of the imitative response class?" and "What conditions produce such control?" This approach is discussed in the following section.

1.2.3 Stimulus Control Theories

Stimulus control accounts of generalised imitation have in common the notion that emission of imitations as a class is controlled by stimuli other than, or not specific to any given to-be-imitated, demonstrated response topography. Steinman (1970b) suggests that two controlling systems may operate concurrently in generalised imitation experiments. One involves experimenter arranged differential reinforcement of one set of imitations. The other, the

social control system, is seen as a composite of social setting events such as the experimenter's instructions, the discriminative properties of the experimenter, continued surveillance by the experimenter, the child's history of consequences of compliance and non-compliance with adults instructions and the absence of any appropriate alternative behaviour on unreinforced trials.

One investigative approach has involved manipulation of antecedent stimuli or setting events which may have acquired control of the imitation response class during subjects pre-experimental history of social interaction. Several studies have involved the manipulation of instructions. Bufford (1971) and Steinman (1970a, 1970b) reported that when "Don't do unreinforced responses" and "Don't care if you do unreinforced responses" instructions were used, unreinforced imitations decreased and recovered respectively, while reinforced imitations were concurrently maintained. Waxler and Yarrow (1970) used a group of comparison design and obtained a greater decrease in imitation under extinction conditions from a "release from instruction" (to imitate) group than from a group not given release from instruction.

Martin, J., (1972) manipulated instructions and contingencies in congruent and incongruent combinations. Under extinction conditions emission of imitations was controlled by the instructions "Do this" and "Don't do this". When consequential contingencies were applied to one set of imitations, the emission of both consequated and unconsequated imitations was controlled by the

contingencies even when these were incongruent with instructions. The incongruent combinations were "Do this" combined with a DRO-0sec contingency, "Do this" with imitation contingent punishment, and "Don't do this" combined with imitation contingent reinforcement. A simple interpretation of these results is that contingencies provide more potent control than antecedent stimuli with pre-experimentally acquired controlling effects. An alternative interpretation is that instructional controlling effects of antecedent stimuli are acquired in accordance with the relationship between them and the other two components of the three term contingency, such that within the experimental situation the verbal instructions acquire new "meaning" (i.e. controlling properties) congruent with contingencies. The finding that both the consequated and unconsequated imitations which were preceded by the same stimuli (i.e., instructions) were members of the same response class supports the latter interpretation.

Peterson and Whitehurst (1971) manipulated experimenter presence versus absence during the 10 sec period immediately following response demonstrations. In a functional analysis conducted under extinction conditions, experimenter presence was shown to control emission of both previously reinforced and never reinforced sets of imitations. Peterson et al., (1971) replicated these results and also demonstrated that during the experimenter absent condition, differential reinforcement of members of one of two sets of imitations produced differential

responding in three of four subjects. For two of these subjects the experimenter present condition was reintroduced. Differential responding was immediately abolished and generalised imitation obtained with both subjects.

These studies involving manipulation of the hypothesised controlling stimuli offer direct evidence supporting Steinman's view that emission of unreinforced imitations is controlled by instructional and social setting stimuli. Inferential evidence supporting this view is also available. Martin, J., (1971) used four severaly retarded boys and in each session presented trials for a set of imitations (cued by response demonstration without using "Do this" instructions) and a set of non-imitations (cued by verbal instructions alone). Half of the subjects initially had only imitations reinforced while the others had only instruction following reinforced. In a functional analysis involving a DRO contingency for the previously reinforced responses, followed by a reversal so that previously unreinforced responses were reinforced, it was demonstrated that imitations and instruction following responses were members of a common response class. Martin argued that once an imitative repertoire is established, imitations may become members of a generalised instruction following response class.

Steinman (1970a, 1970b) and Steinman and Boyce (1971) reported that when trials for unreinforced imitations were interspersed among trials for reinforced imitations, using both single and choice (between reinforced and unreinforced imitations) presentation trials, unreinforced

imitations were emitted on single but not choice presentation trials. Steinman and Boyce (1971), using both single and choice presentation trials within the same sessions, reversed the differential reinforcement contingency so that previously unreinforced imitations were reinforced and vice versa. The relative frequency of imitations from the two sets was correspondingly reversed only on choice trials. The choice presentation procedure enables subjects to avoid performance of unreinforced imitations while still obeying the experimenter instruction "Do this", while the single presentation procedure does not. Seen in this light the above results support the notion of social-instructional control.

Burgess et al., (1970) suggested that imitations may not only be controlled by pre-experimentally established instructional stimuli, but that stimuli present in the experimental situation such as "coincidental" stimuli present on trials for both reinforced and unreinforced imitations or "generalised conditional stimuli" may acquire control during the course of generalised imitation experiments. Gewirtz (1971) likewise suggested imitations may come to be controlled by "conditional" stimuli such as the models behaviour of response demonstration and contextual cues which indicate the likelihood of reinforcement. In a similar vein Baer et al., (1967) remarked that since their subjects were almost certainly able to non-imitatively perform the responses they were trained to imitate, the acquisition curves obtained may have reflected subjects learning of the instruction "Do as the experimenter

does". That is, their training procedures may simply have brought responses already in the repertoire under instructional stimulus control.

Despite the earlier experiments reported by Miller and Dollard (1941) there have been few direct investigations of experimentally produced stimulus control of imitations. These authors trained normal fourth grade boys to imitate or not imitate dependent on whether responses were demonstrated by an adult or child, using differential reinforcement. The same control of imitation was transferred to other adults and children used as models and after establishing appropriate control over three topographically different imitations, imitation of a fourth new response was found to be under appropriate stimulus control on its first demonstration. Steinman (1970b) attempted to produce differential imitation congruent with a differential reinforcement contingency by arranging for trials for reinforced and unreinforced imitations to be presented by different models. However his subjects continued to emit both reinforced and unreinforced imitations.

Berkowitz (1969) trained four profoundly and severely retarded subjects to imitate using food reinforcement, obtained generalised imitation, demonstrated reinforcement control of reinforced and unreinforced sets of imitations and after further training on intermittent reinforcement schedules finally manipulated the independent variable presence versus absence of food in the experimental room, under extinction conditions. Imitation only occurred when food was present, suggesting that imitation

may well come to be discriminatively controlled by stimuli present in the experimental situation other than the demonstrated response topographies or the behaviour of demonstrating the to-be-imitated response irrespective of its topography. A conceptually similar result was obtained by Waxler and Yarrow (1970). They trained normal preschoolers to imitate in a story telling setting, obtained generalised imitation, demonstrated reinforcement control of reinforced and unreinforced imitations using extinction and non-contingent reinforcement procedures, and then measured frequency of imitation in a play setting, a conversation setting, and the original story telling setting but with a new model. Imitations decreased in the first two settings but not in the original training setting despite the new model. This again suggests acquisition of discriminative control of imitations by stimuli (story telling setting) present during establishment of imitation.

Williams (1971) directly investigated acquisition of stimulus control of imitations. Two autistic children were trained to imitate or not imitate a variety of responses demonstrated by two models, according to whether or not the experimenter delivered a reinforcer to model following response demonstration. Imitations following response demonstrations by one model whose demonstrations were reinforced and non-imitations (i.e., other behaviour) following response demonstrations by the other model whose demonstrations were not reinforced were differentially reinforced. Once differential imitation under the control of the model who demonstrated the response or the models

consequence or a composite of both these confounded variables had been established for a training set of imitations, the repertoire was probed with trials for unreinforced imitations. Probe trial response demonstrations were imitated or not imitated in congruence with the three term contingencies applied to the training set of imitations. Two successive changes in the differential reinforcement contingencies were followed on each occasion by appropriate changes in frequency of imitation and non-imitation in relation to antecedent stimuli for one subject. With this subject it was shown that emission of reinforced and unreinforced imitations was controlled by the models consequences. Though conceived by the author as a test of Bandura's "vicarious reinforcement" theory (Bandura, 1965b, 1969a, 1969b, 1971) this study demonstrates that imitations may come to be discriminatively controlled in the experimental setting by stimuli other than verbal instructions or the topographies of the demonstrated responses through the application of differential reinforcement contingencies in the same manner as stimulus control of less complex response classes is established. Though previously cited authors in this section have demonstrated the existence of stimulus control in the experimental setting, only Williams has attempted to produce a plausible experimental analogue of the process through which such control may be established.

CHAPTER II

EXPERIMENTAL RATIONALE AND OVERVIEW

2.1 RATIONALE

The research results discussed in Chapter 1 show that where single presentation trials involving a forced choice between imitating and not imitating are used, and probe trials for unreinforced imitations are interspersed among training trials for reinforced imitations, generalised imitation typically occurs. Alternatively stated, imitation as opposed to non-imitation is not differentially controlled by the stimulus topographies of the set of responses demonstrated on training trials, as opposed to the stimulus topographies of a different set of responses demonstrated on probe trials. Moreover, this absence of differential imitation cannot in several experiments be attributed to an hypothesised inability of subjects to distinguish response demonstrations preceeding reinforced imitations from those preceeding unreinforced imitations.

One investigative approach (Bandura and Barab, 1971) has been to ask why stimuli included as antecedents in a differential reinforcement contingency do not acquire control of the frequency of imitation as would be expected on the basis of research using less complex response classes (Terrace, 1966). An alternative approach to be pursued here, might be to ask what antecedent stimulus elements do control the frequency of imitation in generalised imitation experiments.

This authors view that the frequency of imitation is controlled by antecedent stimuli follows from pilot observations that subjects infrequently imitated the models actions between those response demonstrations designated as trials for imitation and that the low frequency of inter-trial imitations decreased to zero within about five sessions. Other researchers may have obtained similar results. Certainly none of the authors cited have remarked on the excellent discrimination subjects exhibit by only imitating at the "correct" time.

The procedures of most generalised imitation experiments contain readilly identifiable stimulus elements which are included in the compound stimuli presented on trials for imitation and which are common to trials for reinforced imitations (training trials) and unreinforced imitations (generalised imitation or probe trials). Often verbal instructions such as "Do this" or "Say" have been used in the context of both training and probe trials. Several reports demonstrating control of maintained unreinforced imitation by such instructions and by setting factors such as the presence of the model have already been discussed in Chapter 1. It might be speculated that other trial-correlated stimulus elements such as the model looking at the subject or otherwise obtaining an observing response prior to response demonstration, the distinctive behaviour of response demonstration per se, or the models behaviour of waiting a specified period for the subjects imitation could acquire control of imitation during or prior to generalised imitation experiments.

However such stimulus elements are usually inextricably confounded with other elements of the compound stimuli presented on trials for imitation, or have an unspecifiable history in relation to the behaviours they may occassion. In both cases an experimental analysis of any relationship which may exist between control of imitation by such stimulus elements and imitation contingent reinforcement is difficult or impossible. A less speculative approach which will be the basis of the following experiments would be to create an experimental analogue of the situation outlined above using arbitrary experimental stimuli which are unlikely to have been related to imitation or instruction following behaviours during the subjects pre-experimental learning history.

The first stage of this approach will involve an attempt to establish with a small number of children, a discriminative imitative repertoire such that experimenter demonstrations of a number of simple motor behaviours are followed by imitation when the demonstration is accompanied by one experimental stimulus (S+) but are not followed by imitation when the demonstration is accompanied by another experimental stimulus (S-). Imitations of this set of responses (referred to as "training responses") will be reinforced when preceeded by a compound stimulus which includes a training response demonstration and the S+ (i.e. on "S+ training trials"), but will not be reinforced when preceeded by demonstrations of the same training responses together with the S- (i.e. on "S- training trials"). Specifically, the three terms of this S+ training trial

differential reinforcement contingency will be;

(1) the antecedent compound stimulus, consisting of a demonstration of a member of the set of training responses and the presentation of the S+;

(2) the behaviour, which is required to be a response which matches the topography (or in some cases the function) of the response demonstration and which is required to be emitted within 10 sec following the antecedent (i.e. an imitation) and

(3) the reinforcing stimulus, consisting of praise and confectionary items delivered immediately on emission of the required behaviour following presentation of the antecedent stimulus specified above.

The upper half of Table 1 shows a simplified outline of the discrimination training contingencies.

If the discriminative imitative repertoire is established this will demonstrate that implicit instructional or setting effects, such as those found by Peterson et al., (1971) where unreinforced imitation was maintained during "experimenter present" but not during "experimenter absent" conditions and which may well have pre-experimental origins, can be over-ridden by differential reinforcement procedures since demonstrations of the same set of responses would be imitated or not imitated in the presence of the experimenter or other stimulus elements or setting factors common to both S+ and S- training trials. In addition the establishment of such a repertoire would imply the substitution of control by an experimental stimulus with a known acquisition history for control by unknown elements of the preceeding compound

stimuli and/or setting factors with an unspecifiable history of acquisition of controlling properties.

On the basis of reported experimental results (e.g. Baer et al., 1967) the successful establishment of an experimental stimulus controlled imitative repertoire would be expected to generate data showing:

(1) accelerated acquisition of imitations of successive new training responses;

(2) an increasing likelihood of imitation of successive new training responses on their first S+ training trial demonstration; and

(3) a decreasing likelihood of imitation of successive new training responses on their first S- training trial demonstrations, as the number of different imitations successively discrimination trained to criterion is increased.

TABLE 1

A simplified outline of the discrimination training procedure conducted on training trials (upper half of table) and the procedure for probe trials interspersed among training trials (lower half of table).

Type of Response Demonstrated	Experimental Stimulus Accompanying Response Demonstration	Type of Trial	Reinforcement Contingency
Members of Training Set	S+	S+ training trial	Imitations Reinforced
	S-	S- training trial	Imitations not Reinforced
Members of Probe Set	S+	S+ probe trial	Imitations not Reinforced
	S-	S- probe trial	Imitations not Reinforced

In the event that the desired repertoire is established, this will be probed with interspersed demonstrations of further new responses (referred to as "probe responses") accompanied equally often by the S+ ("S+ probe trials") and the S- ("S- probe trials"). Imitations emitted on S+ and S- probe trials will not be reinforced. A simplified outline of the probe trial procedure is shown in the lower half of Table 1. It is expected that probe trials will generate data showing:

(1) a greater frequency of imitation on S+ probe trials than on S- probe trials,

(2) a frequency of imitation on S+ probe trials similar to that obtained on S+ training trials and

(3) a frequency of imitation on S- probe trials similar to that obtained on S- training trials.

If the expected results are obtained, then the repertoire will be probed in the same manner over further sessions to determine whether the differential imitation on S+ probe trials, as opposed to on S- probe trials, will be stably maintained.

If the differential emission of unreinforced imitations on S+ probe trials (generalised imitation) is maintained, the question of whether this stimulus control is dependent on the inclusion of the S+ as an antecedent stimulus in the differential reinforcement contingency for S+ training trial imitations will be investigated. The relationship between the antecedent experimental stimuli and delivery of reinforcement on training trials will be reversed so that the stimulus which was previously the S- becomes the S+

included in the differential reinforcement contingency for S+ training trial imitations and the stimulus previously designated as S+ becomes the S-. It is expected that the frequency of imitation will decrease on the new S- training trials and increase on the new S+ training trials to an extent where the imitation frequency is clearly greater on S+ training trials than on S- training trials. This change in performance will be referred to as a behavioural reversal to differentiate it from the procedural reversal. It is also expected that behavioural reversal will occur on probe trials. This latter result would demonstrate the existence of a functional relationship between the stimulus control of unreinforced probe trial imitations and the inclusion of the controlling antecedent stimulus in the three term contingency for training trials.

The experimental design outlined here is similar in one respect to those used by researchers cited in Chapter I in that imitations of demonstrations of one set of (training) responses are reinforced while imitations of another set of (probe) responses are not reinforced. However in the terminology used here, these researchers (except Williams, 1971) presented only S+ training and probe trials. That is probe trial presentations shared all of the antecedent stimulus elements of training trials, including instructions such as "Do this" or "Say", except the topographies of the responses demonstrated. Hence the design of these experiments did not allow investigation of the potential role of antecedent stimulus elements other than the topography of the response demonstrations per se in

controlling the frequency of imitation.

The experimental design to be used here will differ in that S- as well as S+ training and probe trials will be conducted. The compound stimuli presented on S- trials will not include the stimulus element (S+) which will be an antecedent for all reinforced imitations. It will be possible to probe the imitative repertoire with presentations of compound stimuli which either do, or do not, include the stimulus element which is an antecedent for reinforced imitations on S+ training trials (i.e. with S+ and S- probe trials respectively). Hence the potential controlling properties of antecedent stimuli correlated with the emission of reinforced imitations will be able to be studied.

The occurrence of results consistent with the expectations outlined here would argue against the conditioned reinforcement account of generalised imitation and would support the general views of Martin, J. (1971a, 1971b, 1972) Peterson (Peterson and Whitehurst, 1971; Peterson et al., 1971) and Steinman, (Steinman, 1970a, 1970b; Steinman and Boyce, 1971) that the occurrence of generalised imitation is related to some form of stimulus control of an imitative response class variously conceptualised in terms of social setting effects and/or instructional control. Such findings may be able to be conceptualised in terms of instructional control of a response class following Goldiamond's (1966) analysis of complex behaviour.

A failure to obtain the expected results would not directly support Baer's conditioned reinforcement account (Baer et al., 1967) but would detract from the generality of

any attempt to account for generalised imitation in terms of control by antecedent stimuli other than the topography of demonstrated responses.

2.2 OVERVIEW OF EXPERIMENTS

2.2.1 Experiment 1

The procedures of this experiment were designed to establish an experimental stimulus controlled repertoire of imitations of training response demonstrations. This was a prerequisite repertoire for investigation of the stimulus control of unreinforced imitations. The desired repertoire was established with one developmentally retarded subject. Training was discontinued for the other four subjects because of difficulties in establishing the prerequisite repertoire or because of unmanageable agressive and disruptive behaviour.

2.2.2 Experiment 2

The investigation was continued using the single successful subject from Experiment 1. The imitative repertoire was probed with S+ and S- probe trial demonstrations of 21 new responses to which imitations were not reinforced. Unreinforced imitations occurred on S+ probe trials but not on S- probe trials as expected. Six of the probe responses were then presented on interspersed S+ and S- probe trials in each of 15 sessions and the expected stimulus control of unreinforced imitation was maintained. The differential reinforcement contingency for S+ training trial imitations was then reversed. Behavioural reversal

occurred on training trials but the probe trial results were ambiguous. A second set of six probe responses was introduced and a further reversal was conducted with similar results to the first. However there was some evidence that the expected probe trial results might be obtained under altered experimental conditions.

2.2.3 Experiment 3

Following an informal investigation to identify conditions under which stimulus control of unreinforced imitations might be more clearly demonstrated, a further experiment was conducted with the subject used in Experiment 2. New sets of training and probe responses were introduced. The differential reinforcement contingency for S+ training trials was then reversed till behavioural reversal had occurred on training trials following which a second reversal was conducted. The behavioural changes on probe trials were more consistent with expectations but were not maintained.

2.2.4 Experiment 4

The basic experimental sequence was repeated with a developmentally normal child of similar mental age to the previous subject, under conditions considered more optimal for demonstration of stimulus control of unreinforced imitations. A stimulus controlled repertoire of imitations of training responses was established. The repertoire was probed with interspersed S+ and S- probe trials and the differential reinforcement contingency for S+ training trials was reversed twice under conditions of intermittent

differential reinforcement of S+ training trial imitations. A third reversal was then conducted under conditions of continuous differential reinforcement of S+ training trial imitations. All these experimental manipulations produced results consistent with the expectations outlined in the rationale.

CHAPTER III

EXPERIMENT 1: ESTABLISHING A STIMULUS CONTROLLED SET OF IMITATIONS

3.1 INTRODUCTION

A prerequisite repertoire for the demonstration of stimulus control of unreinforced imitations was a set of imitations whose performance or non-performance was controlled by arbitrary experimental stimuli not ordinarily related to demonstration of to-be-imitated responses. The procedures of this experiment were designed to establish such a repertoire and collect data describing the process.

3.2 METHOD

3.2.1 Subjects

Five female developmentally retarded subjects were selected from the population of a villa housing profoundly to moderately retarded residents at Templeton Hospital and Training School. Selection criteria were that the subjects:

(1) were ambulent,

(2) were able to remain continent during 30 minute experimental sessions,

(3) did not exhibit sensory or motor disabilities preventing performance of various motor actions in response to visual and auditory stimuli,

(4) did not frequently engage in behaviours competing with those to be established, and that

(5) inexpensive items selected as potential reinforcers did function to reinforce behaviours they

were contingent on over the first few sessions.

The subjects were all able to follow simple instructions. Subject 2 was only able to imitate a few words. The other subjects could hold a limited conversation. They were not pre-tested for, or excluded on the grounds of, ability to imitate motor actions since the investigation was to focus on acquisition and maintenance of stimulus control rather than acquisition of imitations per se. See Table 2 for other subject characteristics.

TABLE 2

Some characteristics of subjects selected for Experiment 1.

Subject Number	Sex	Chronological Age	Years in Institution	Measured IQ (Stanford-Binet, L-M)
1	F	13 yrs 10 mths	8 yrs 4 mths	39
2	F	12 yrs 11 mths	8 yrs 9 mths	< 30
3	F	12 yrs 10 mths	7 yrs 8 mths	34
4	F	13 yrs 11 mths	7 yrs 9 mths	< 30
5	F	10 yrs 9 mths	7 yrs 4 mths	51

The choice of developmentally retarded subjects was influenced by their use in the notable early functional analyses of imitation (e.g., Baer et al., 1967; Peterson, 1968) and by the consideration that this population were most likely to benefit from therapeutic applications derived from research in this area. The convenience of having subjects resident in the same place for a series of experiments expected to occupy several months was also an important consideration.

3.2.2 Setting

Subjects were seen individually in 15 to 30 minute sessions held once or occassionally twice a day on three up to six days per week. Sessions were conducted in an office containing a standard office desk and chair, three other plain chairs, a smaller table supporting the reinforcer dispenser, two four drawer vertical filing cabinets and book shelves.

3.2.3 Apparatus and Materials

A mechanical dispenser was used to deliver reinforcer items one at a time into a shallow cup. Dispenser operation was clearly audible, providing a potential conditioned reinforcing stimulus. The dispenser cabinet also enclosed a six volt buzzer. The dispenser and buzzer were independently and remotely operable by hand held switches attached to a 3 m flex from the dispenser control box.

Mixtures of small confections such as Smallsorts, Liquorice Bullits, Smokers and Dolly Mix and for Subjects 3, 4 and 5 only, one cent pieces, were used as potential reinforcers. A variety of items was used in each session as suggested by Bijou and Sturges (1959) to reduce the liklihood of loss of reinforcer potency which may occur in studies extending over long periods.

A stop watch, pre-pared data recording sheets and objects required for the demonstration and imitation of various motor responses were also used.

3.2.4 Dispenser Training

One to three sessions were used familiarising subjects with the experimenter and experimental room while training them to approach the dispenser and collect delivered

items following its operation. Dispenser training involved three stages similar to procedures for magazine training non-human species (Ferster and Skinner, 1957, p.31). During the first stage the dispenser cup was filled with sweets for subjects to take and eat at any time. Subjects who did not take sweets were told to do this. In the second stage the dispenser cup was normally empty and the dispenser was operated when subjects were close to it. In stage three the dispenser was only operated when subjects moved away from it, to reduce standing-by-the-dispenser behaviour and extend stimulus control of dispenser approach.

Subjects who did not take and eat sweets within two sessions were to be rejected on grounds that according to the Premack Principle (Premack, 1965) the items available were unlikely to reinforce the behaviour of these subjects. However no subjects were rejected for this reason.

3.2.5 Discrete Trial and Data Collection Procedures

Sessions consisted of a variable number of discrete trials. Before each session the responses to be used and their demonstration order was determined and entered on the session data sheet (see Table 3) with each trial designated S+ (imitations reinforced on some schedule) or S- (imitations not reinforced). On each trial the experimenter waited till the subject was looking at him, demonstrated a response, then observed in a standardised manner (looking directly at the subject without making eye contact while maintaining a neutral facial expression) during a 10 second opportunity to imitate period. On some trials the buzzer was operated for 2 seconds immediately following response demonstration.

TABLE 3

A sample portion of a prepared data sheet as it might appear before an experimental session.

Subject:_____ Date:_____ Session:____			
Trial No.	Response	S+ or S-	Score 1 or 0
1	Raise left arm	+	
2	Tap table	-	
3	Raise left arm	-	
4	Nod yes	+	
5	Tap table	-	
6	Stand on chair	+	

Following Peterson (1968b), a subjects response was scored as an imitation if it either duplicated the topography of the response demonstration or if the subject used an object in the same way as the experimenter. Unlike Peterson's procedure, the response was required to occur within 10 seconds rather than 30 seconds. Imitations and non-imitations were scored as "1" and "0" respectively on the data sheet. The procedure following trial presentations differed according to the type of trial and its outcome (see Table 4).

TABLE 4

Outline of procedure following S+ and S- training trial presentations for different trial outcomes.

Trial Outcome	Trial Type	Following Procedure (actual order of events described below)
One or more imitations emitted during 10 sec. opportunity	S+	(1) Immediate reinforcement of first imitation if scheduled for that trial. Record "1" on data sheet. Wait 10 seconds. Proceed to next trial on data sheet. If reinforcement is intermittent and not scheduled for that trial, use procedure (2) without correction procedure.
	S-	(2) Wait for 10 seconds after last imitation. Record "1" on data sheet. Proceed to next trial on data sheet or, if correction procedure in use, repeat trial till a no imitation trial obtained then proceed to next trial.
No imitations emitted during 10 sec. opportunity	S+	(3) At end of 10 second opportunity record "0" on data sheet. Proceed to next trial on data sheet or, if correction procedure in use, repeat trial (using additional procedures if necessary)* till imitation obtained, reinforce, record result, wait 10 seconds, then proceed to next trial.
	S-	(4) At end of 10 second opportunity record "0" on data sheet. Proceed to next trial on data sheet

* Additional procedures used in S+ correction trials are described in the following section on "S+ Trial Training of New Imitations".

Imitation was scored on an all or none basis. Where more than one imitation was emitted during the 10 second opportunity to imitate period the trial score remained "1". Imitation approximations reinforced during use of a shaping procedure and otherwise appropriate imitations occassioned by prompts in addition to response demonstration per se were scored "0". Where imitations were to be reinforced this was done before recording the trial score to maintain immediacy of reinforcement. Trial score recording for not-to-be-reinforced imitations was always delayed for 10 seconds following emission of the last imitation to eliminate a potential source of unplanned reinforcement. Similarly, presentation of the next trial, a potential conditioned reinforcer, was always delayed for 10 seconds following any imitation including responses with matching topography occurring after the 10 second opportunity to imitate period, to avoid chaining. The data sheet was located behind a screen to eliminate another potential source of unplanned influence over the subjects behaviour.

After each session the percentage of trials on which imitation occurred (percent imitation) was calculated and plotted on a graph separately for S+ and S- trials. Correction trial scores, recorded to obtain data on the number of trials required to establish new S+ trial imitations, were not included in the calculation of percent imitation.

3.2.6 Reliability of Observation

During one session for Subjects 2 through 5 and two sessions for Subject 1, an observer conducted a reliability check. The observer used a data sheet the same as the

experimenter's and was asked to score trials using the same criteria. Though neither the experimenter or the observer could see what the other recorded a potential source of mutual influence existed in that both could see when the other was recording. Total screening was not practicable so to minimise experimenter influence over the observer, the observer was asked to try to record before the experimenter.

Reliability, expressed in terms of percent agreement was calculated using the equation below, following the procedure suggested by Bijou, Peterson, and Ault (1968).

$$\% \text{ Agreement} = \frac{\text{Number of Agreements} \times 100}{\text{Number of Agreements} + \text{Disagrements}}$$

3.2.7 S+ Trial Training of New Imitations

The required terminal behaviour for S+ trials was that on the occassion of the experimenter demonstrating a response directly followed by S+ presentation (2 second buzzer operation for Subjects 1 to 4, absence of buzzer for Subject 5), a response of the same topography or function was emitted within 10 seconds. This was achieved using a combination of physical guidance, prompting, fading, shaping and positive reinforcement procedures following the method reported by Baer et al., (1967). Unlike many studies (e.g. Baer et al., 1967; Peterson, 1968b; Steinman, 1970b) the instruction "Do this" was never used.

The procedures were applied as follows. To train imitation of the response "tap the table" for example, if the subject did not begin to respond within about four seconds following an S+ correction trial presentation, the experimenter reached out, grasped the subjects wrist, tapped the hand on

the table (physical guidance) and immediately delivered a reinforcer. On subsequent S+ correction trials response support was faded out. That is the experimenter took the subjects hand only part of the way and shaped up response completion. Physical guidance was faded out over successive trials till the experimenter only touched the subjects arm. This prompt was also faded out till the subject emitted unprompted imitations. The shaping procedure also involved reinforcement of otherwise correct responses when they occurred after the 10 second opportunity to imitate period had elapsed.

The responses demonstrated to each subject are listed in Tables 5, 6, 7 and 8 in the order of their introduction to training. All new responses up to number 10 were first demonstrated in the context of an S+ trial. The manner of proceeding through various stages of training differed slightly between subjects. Subjects 1 and 2 were trained to imitate two different responses on S+ trials before proceeding to discrimination training involving presentation of both S+ and S- training trials. Subjects 3, 4 and 5 were trained to imitate only one response before discrimination training.

3.2.8 Discrimination Training

3.2.81 Terminal Behaviour

The required terminal behaviour was that during the 10 second opportunity to imitate period, imitation occurred on S+ training trials but did not occur on S- training trials. The discrimination criterion was that

The sequence of responses demonstrated to Subject 1 over sessions 3 to 127 in Experiment 1, listed in order of introduction to training. The symbols + and - show whether the response was first demonstrated in the context of an S+ or S- training trial respectively.

Response Number	Response Description	First Demonstration	Session Introduced
1	Raise left arm	+	3
2	Tap table with left hand	+	7
3	Nod yes	+	33
4	Stand on chair	+	44
5	Lift chair	+	73
6	Hop two times	+	78
7	Kneel on floor	+	82
8	Tap chest with left hand	+	91
9	Tap head with left hand	+	95
10	Tap left knee with left hand	+	99
11	Tap right knee with left hand	+	101
12	Tap nose with left hand	-	101
13	Tap table leg	+	103
14	Left arm forward and horizontal	-	104
15	Sit on chair	-	105
16	Hands on ears	+	106
17	Both arms forward and horizontal	-	107
18	Walk to door	+	108
19	Right arm sideways and horizontal	-	109
20	Tap head with right hand	+	110
21	Tap right knee with right hand	+	111
22	Tap left knee with right hand	-	112
23	Raise right arm	-	113
24	Tap chest with right hand	+	114
25	Tap table with right hand	-	115
26	Move chair	-	116
27	Open door	+	117
28	Move ash tray	+	118
29	Put on hat	-	119
30	Sit on two chairs in sequence	+	119
31	Put circle in formboard	+	120
32	Put circle, square and cross in formboard	-	120
33	Put box over block	+	120
34	Walk round chair	-	120
35	Build three block tower	-	121
36	Roll ball along floor	+	121
37	Nod no	-	121
38	Stretch rubber band	+	121
39	Kick ball	+	122
40	Hands over eyes	-	122

TABLE 6

The sequence of responses demonstrated to Subject 2 over sessions 2 to 169 in Experiment 1, listed in order of introduction to training. All responses were first demonstrated in the context of S+ training trials.

Response Number	Response Description	Session Introduced
1	Raise left arm	2
2	Tap table with left hand	2
3	Tap chest with left hand	79
4	Tap head with left hand	113
5	Tap left knee with left hand	118
6	Tap right knee with left hand	130
7	Tap nose with left hand	135

TABLE 7

Responses demonstrated to Subjects 3 and 4 over sessions 4 to 38 and 4 to 40 respectively in Experiment 1. Responses were first demonstrated in the context of S+ trials.

Response Number	Response Description	Session Introduced	
		Subject 3	Subject 4
1	Raise left arm	4	4
2	Tap table with left hand	11	-

TABLE 8

The sequence of responses demonstrated to Subject 5 over sessions 1 to 118 in Experiment 1, listed in order of introduction to training. The symbols + and - show whether the response was first demonstrated in the context of an S+ or S- training trial.

Response Number	Response Description	First Demonstration	Session Introduced
1	Raise left arm	+	1
2	Tap table with left hand	+	15
3	Tap chest with left hand	+	44
4	Tap head with left hand	+	46
5	Tap left knee with left hand	+	48
6	Tap right knee with left hand	+	52
7	Tap nose with left hand	+	58
8	Tap table leg	+	64
9	Left arm forward and horizontal	+	67
10	Circular motion with left arm	+	70
11	Sit on chair	+	72
12	Hands on ears	-	74
13	Nod yes	+	75
14	Tap chair seat	-	76
15	Both arms forward and horizontal	+	77
16	Right arm sideways and horizontal	-	78
17	Walk to door	+	79
18	Tap head with right hand	-	80
19	Tap right knee with right hand	+	81
20	Tap left knee with right hand	-	82
21	Raise right arm	+	85
22	Tap chest with right hand	-	86
23	Tap table with right hand	+	87
24	Move chair	-	88
25	Stand on chair	+	89
26	Open door	-	90
27	Move ash tray	+	102
28	Place paper on chair	-	104
29	Sit on two chairs in sequence	+	105
30	Move box	-	107

percent imitation was greater than or equal to 80 percent and less than or equal to 20 percent on S+ and S- training trials respectively.

3.2.82 Stimuli used for S+ and S-

For Subjects 1, 2, 3 and 4 the S+ was a 2 second buzzer operation immediately following response demonstration. The S- was the absence of this signal. For Subject 5 this arrangement was reversed.

3.2.83 Training Procedure

The basic procedure was differential reinforcement of S+ trial imitations. Non-imitation on S+ training trials was followed by S+ correction trials involving the previously described prompting and fading procedures when necessary till an unprompted imitation occurred. Imitation on an S- training trial was followed by S- correction trials (extinction procedure) till a no imitation S- training trial occurred. To prevent subjects learning not to observe S- trial response demonstrations, stimulus presentation always followed rather than preceded demonstrations. Remaining details have already been described in the "Discrete Trial and Data Collection Procedures" section.

3.2.9 Overview of Training Procedures

3.2.91 Introducing Responses Numbered 1 to 9

The procedures used during sessions devoted to training responses numbered 1 and 2 were not standardised. These sessions comprised a pilot stage where appropriate training and recording procedures were developed. Nevertheless the procedures did not differ greatly from those adopted for the introduction of further responses up to number 9.

For responses numbered 3 up to 9 no more than one new response was introduced in any session. Each new response was first demonstrated in the context of an S+ training trial. If imitation did not occur on that trial, the imitation was trained as described in the "S+ Trial Training of New Imitations" section till one unprompted imitation was obtained.

The discrimination training procedure was then applied for the new imitation alone till the discrimination criterion was met for one session (Subjects 2 and 5) or two successive sessions (Subject 1). Subjects 2 and 3 did not proceed to this stage of training. Sessions consisted of 40 trials plus correction trials where required. Trials were quasi-randomised anew for each session so that each block of four contained two S+ and two S- trials (not including correction trials). No more than two consecutive S+ or S- trials were allowed.

Trials for the new imitation were then included amongst trials for previously established imitations and discrimination training was continued till the criterion was again met for one (Subjects 2 and 5) or two successive sessions (Subject 1). Sessions consisted of the closest approach to 40 trials obtainable using multiples of two times (for S+ and S- training trials) the number of different responses to be demonstrated, plus correction trials where required. Trials were quasi-randomised anew for each session in blocks of two or four times the number of different responses to be demonstrated such that each response demonstration appeared equally often, and equally often on S+ and S- trials within each block (not including correction trials). No more than two successive S+ or S- trials or

demonstrations of the same response (again not including correction trials) were allowed.

When the discrimination criterion had been met, the procedure recycled to the introduction of a further new response demonstration and so on till a stimulus controlled set of imitations of 9 different training responses had been established.

3.2.92 Introducing Responses Numbered 10 up to 25 and 20 for Subjects 1 and 5 Respectively

For Subjects 1 and 5 who reached this stage of training, furthernew response demonstrations were introduced at a maximum rate of one per session, directly into discrimination training sessions including trials for previously established imitations. Introduction of a new response was dependent on the discrimination criterion being met in the previous session. The first two demonstrations of each new response always included one on an S+ trial and one on an S- trial (not including demonstrations on correction trials). The order was counterbalanced with respect to S+ and S- trials (see Tables 5 and 8) to obtain a progressive estimate of the probability of imitation of new responses on their first S+ and S- trials, which would not be confounded with the order of these two trials.

Each session contained 40 trials (not including correction trials) and involved demonstrations of only the 10 most recently introduced responses including the one to be introduced in that session. Trials were quasi-randomised anew for each session in one block of 40 trials with restraints that no more than two consecutive S+ or S- trials, or trials involving demonstration of the same response were allowed,

and that each response appeared equally often on S+ and S- training trials.

3.2.93 Introducing Further New Responses

The procedure changes described in this section apply to the introduction of responses numbered 26 up to 40 for Subject 1 and 21 up to 30 for Subject 5. The main change was to increase the number of different responses demonstrated in each 40 trial session from 10 to 20. Each response was demonstrated once on an S+ and once on S- training trial (not including correction trials). Trials were quasi-randomised as before. The 20 responses demonstrated in each session included those being introduced in that session complemented by randomly selected reponses from the pool of those for which imitations had previously been trained.

New responses were still introduced a maximum rate of one per session as described in the previous section for Subject 5 and for responses numbered 26 up to 28 for Subject 1. With Subject 1, responses numbered 29 up to 40 were introduced at the rate of two or four per session (see Table 5) without disrupting the discrimination performance.

3.3 RESULTS

3.3.1 Reliability

Agreement between the experimenter and observer recording over the six reliability check sessions ranged from 92 to 100 percent with a mean of 96 percent.

3.3.2 Dispenser Training

Dispenser training was completed in three or fewer

sessions. The sweets reinforced the behaviour of all subjects. No subjects exhibited competing behaviours warranting their rejection at this stage, though one potential subject was rejected for incontinence. After dispenser training, all subjects came from any point in the room and took and ate sweets from the cup immediately following dispenser operation.

3.3.3 S+ Trial Training of New Imitations

Subjects 1, 2, 3, 4 and 5 acquired 40, 7, 2, 1 and 30 imitations respectively. All subjects quickly acquired new S+ trial imitations, though physical guidance, prompting and fading procedures were often required in the early stages. Limitations in the number of imitations trained were related to difficulties with discrimination training rather than with S+ trial acquisition per se. Figure 1 shows S+ trial acquisition data for Subjects 1 and 5. The number of trials (including correction trials) required to obtain each new unprompted S+ trial imitation decreased as the number of previously trained imitations increased. Figure 2 shows a similar trend for a smaller number of responses with Subjects 2 and 3.

Initially subjects did not often look at the experimenter. This behaviour was trained by making trial presentation, which was likely to become a conditioned reinforcer, contingent on looking at the experimenter for short, then longer periods. Another problem during early training was emission of inter-trial imitions appropriate for the previous trial. This was eliminated in five to 10 sessions by delaying presentation of the next trial till 10

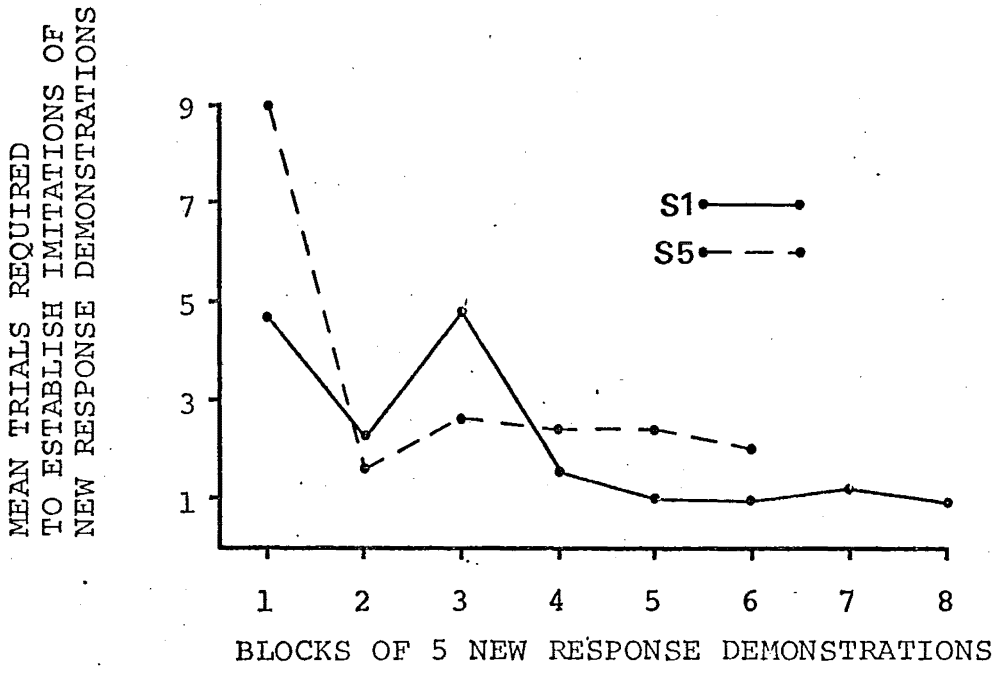

FIGURE 1 Mean number of trials required to establish S+ trial imitations of new response demonstrations to a criterion of one unprompted imitation with Subjects 1 and 5 in Experiment 1.

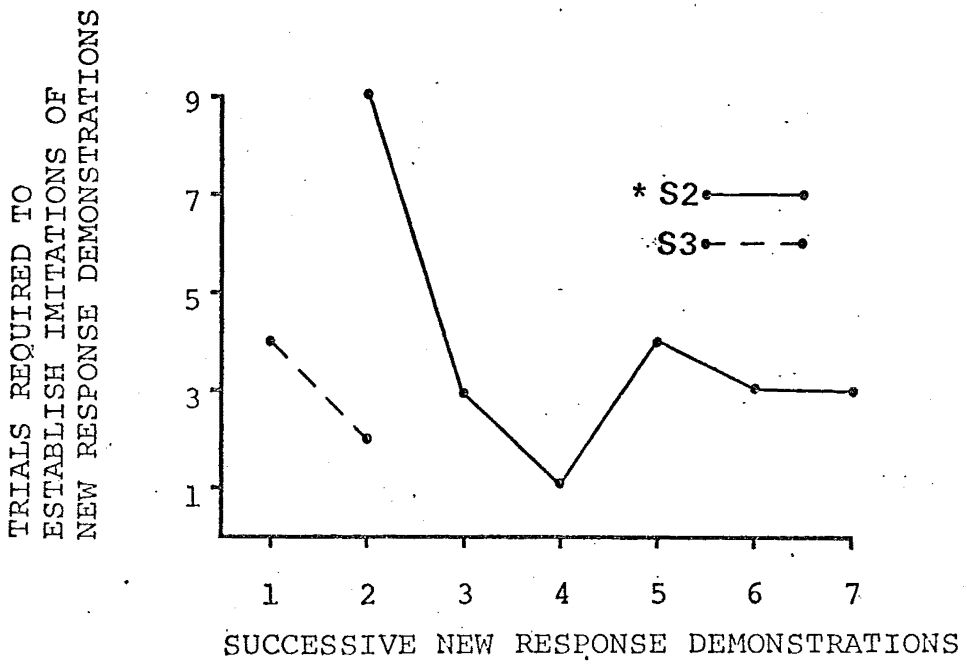

FIGURE 2 Number of trials required to establish S+ trial imitations of new response demonstrations to a criterion of one unprompted imitation with Subjects 2 and 3 in Experiment 1.

* Data lost for first new response demonstration.

seconds had elapsed since the last inter-trial response.

During training of the first response, "raise left arm", a problem of mirror image responding associated with development of a right arm then left arm raising chain arose with Subjects 1 and 5. This was largely eliminated over three to four sessions using prompting and differential reinforcement of unchained imitations.

3.3.4 Discrimination Training

Only Subject 1 acquired a stable stimulus controlled repertoire of diverse imitations. The repertoires of Subjects 2 and 5, though ultimately unstable, were sufficiently developed to provide some additional data relating to the development of stimulus control.

3.3.41 First S+ and S- Trials for New Imitations

Data from first S+ and S- trial demonstrations of new responses provided a measure of progress toward establishing a stimulus controlled imitative response class. For Subjects 1 and 5, Figure 3 shows an increase in the number of first S+ trial imitations of new responses and a decrease in the number of first S- trial imitations of the same responses as the number of responses included in discrimination training increased. An exception to this generalisation was the performance of Subject 5 on first S- trials during introduction of the sixth block of five new responses (see Figure 3). The increase in first S- trial imitations was associated with a loss of stimulus control of the previously established repertoire of 25 imitations occurring over most sessions from 91 to 119 (see Figure 11).

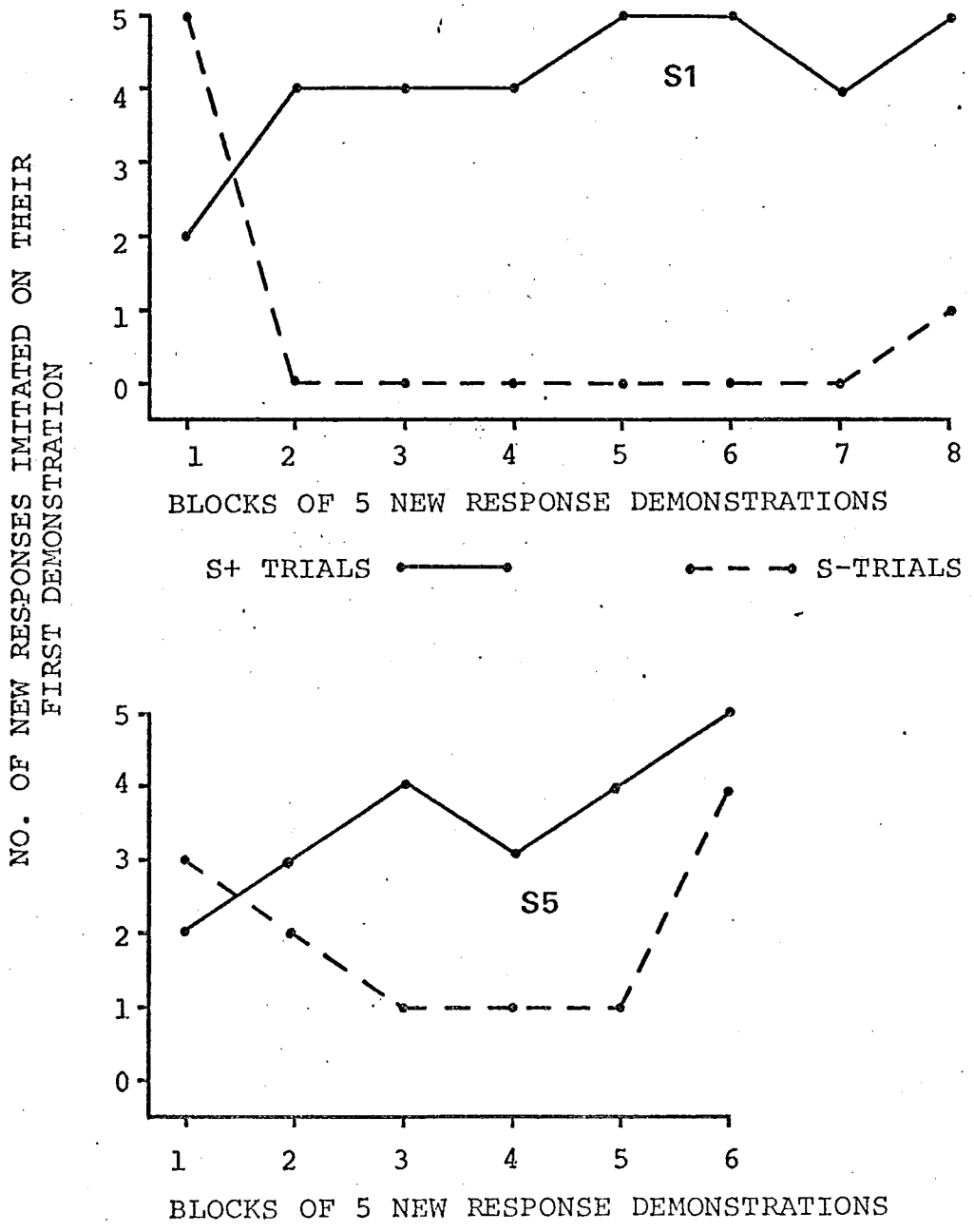

FIGURE 3 Number of new responses imitated on their first S+ and S- trial demonstrations for Subjects 1 (top) and 5 (bottom) in Experiment 1.

Though the trend was for Subject 2 to require fewer S+ training trials to acquire successive new imitations (see Figure 2), there was no systematic divergence of the number of first S+ and S- trial imitations for the seven responses introduced (see Table 9).

TABLE 9

First S+ and S- trial data from Subject 2 in Experiment 1.

Response Number	Imitation on First Trial?	
	First S+ Trial	First S- Trial
1	No	No
2	No	No
3	No	Yes
4	Yes	Yes
5	No	Yes
6	No	No
7	No	No

Subjects 1, 2 and 5 imitated the first five new response demonstrations more often on first S- trials than on first S+ trials. The first demonstration of responses numbered 1 to 10 was always on an S+ trial. If no imitation occurred, S+ correction trial demonstrations followed to train the new imitation before the first S- trial demonstration was presented. This procedure probably

accounts for the above result. The reversal of this performance by Subjects 1 and 5 during introduction of the second block of five new responses where the same procedure was used suggests that continued discrimination training had begun to establish stimulus control over emission of new imitations despite the contaminating effect of the introduction procedure. Data for the remaining new responses were uncontaminated by confounding with the order of first S+ and S- trial response demonstrations.

3.3.42 Rate of Introducing New Responses

A second measure of the development of stimulus control of the developing imitative response class was provided by data on the rate of introduction of new responses, since this was in turn dependent on the rate of achieving the discrimination criterion following introduction of the previous new response.

Figure 4 shows the accelation of acquisition of differential performance with respect to S+ and S- training trials of new imitations for those subjects which at least temporarily acquired discriminative repertoires of five or more imitations (Subjects 1, 2 and 5). To some extent the acceleration shown for Subjects 1 and 5 following the arrows lettered "a" on Figure 4 reflects the effect of procedure changes described in the "Overview of Training Procedures" section which allowed more rapid introduction of new responses. However the increased rate of response introduction which made these changes possible is also evident on the cumulative curves prior to the procedure changes.

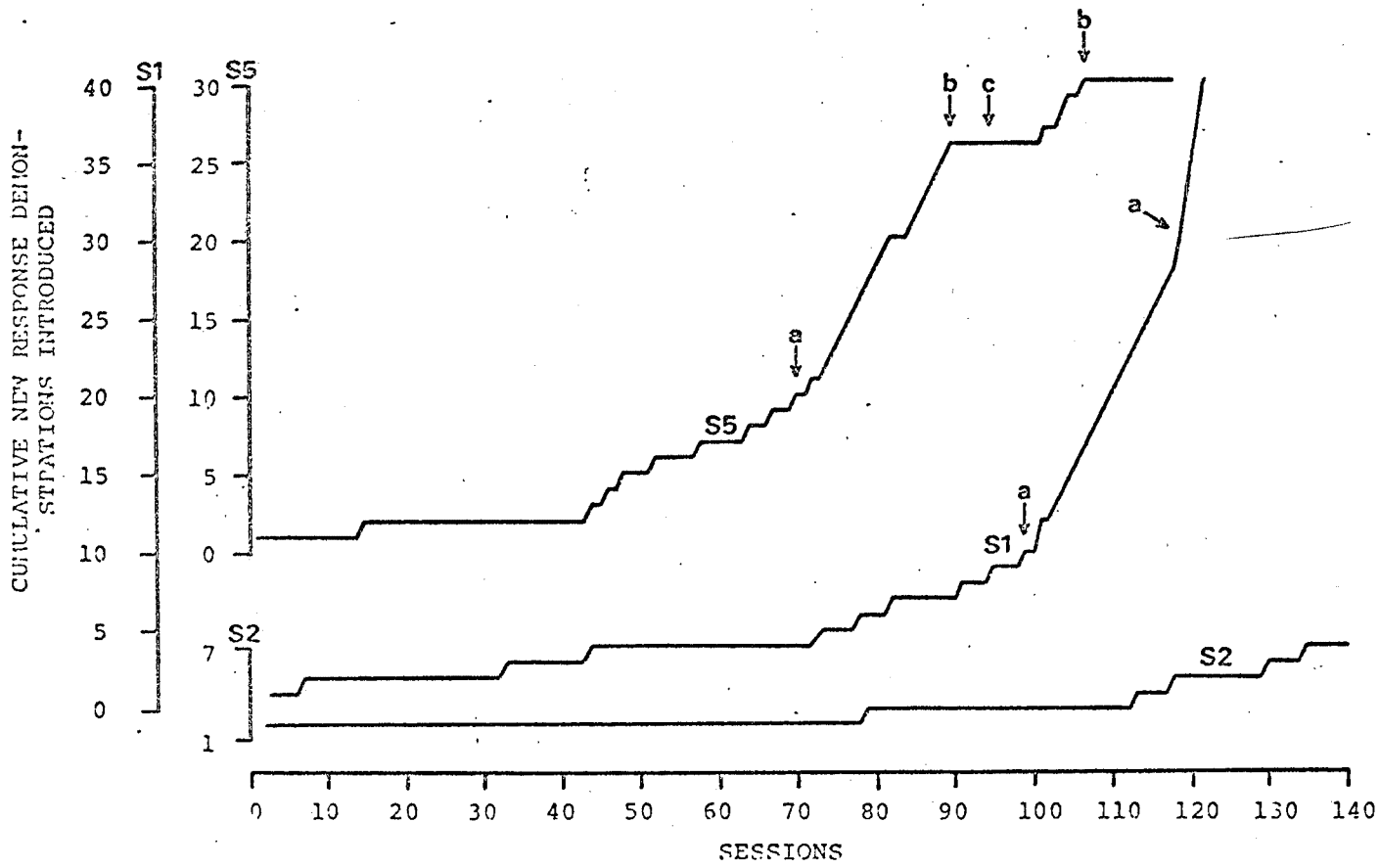

FIGURE 4 Cumulative new response demonstrations introduced into discrimination training sessions for Subjects 1 (middle), 2 (bottom) and 5 (top) in Experiment 1. Lettered arrows indicate: (a) procedure changes allowing more rapid introduction of new responses; (b) loss of stimulus control of previously established imitations; (c) introduction of time out contingent on S- trial imitation.

At the arrows labelled "b" on the cumulative curve for Subject 5 the following deceleration was related to a loss of stimulus control of the previously established repertoire. At the arrow labelled "c" on the same curve, a time out contingent on emission of S- trial imitations was introduced in an attempt to re-establish the discriminative performance. Data related to this aspect of the performance of Subject 5 is presented in the following section.

3.3.5 Performance of Individual Subjects

3.3.51 Subject 1

Figure 5 shows S+ and S- training trial percent imitation for individual sessions throughout the discrimination training required to establish a stimulus controlled repertoire of 40 imitations with Subject 1.

In section a the responses "raise left arm" and "tap table" received discrimination training. The differential performance evident at the end of this section represented a repertoire where the low S- trial percent imitation resulted from performance of an "incorrect" alternative to imitation (raise right arm). This S- trial behaviour was considered undesirable in relation to the required terminal behaviour that S- trial percent imitation be less than or equal to 20 percent for a variety of responses, not all of which would have convenient incorrect alternatives to imitation.

Section b of Figure 5 shows results of further training with response 1 alone. For Sessions 24-26 a massed extinction procedure where only S- trials were presented was used before returning to the usual discrimination training

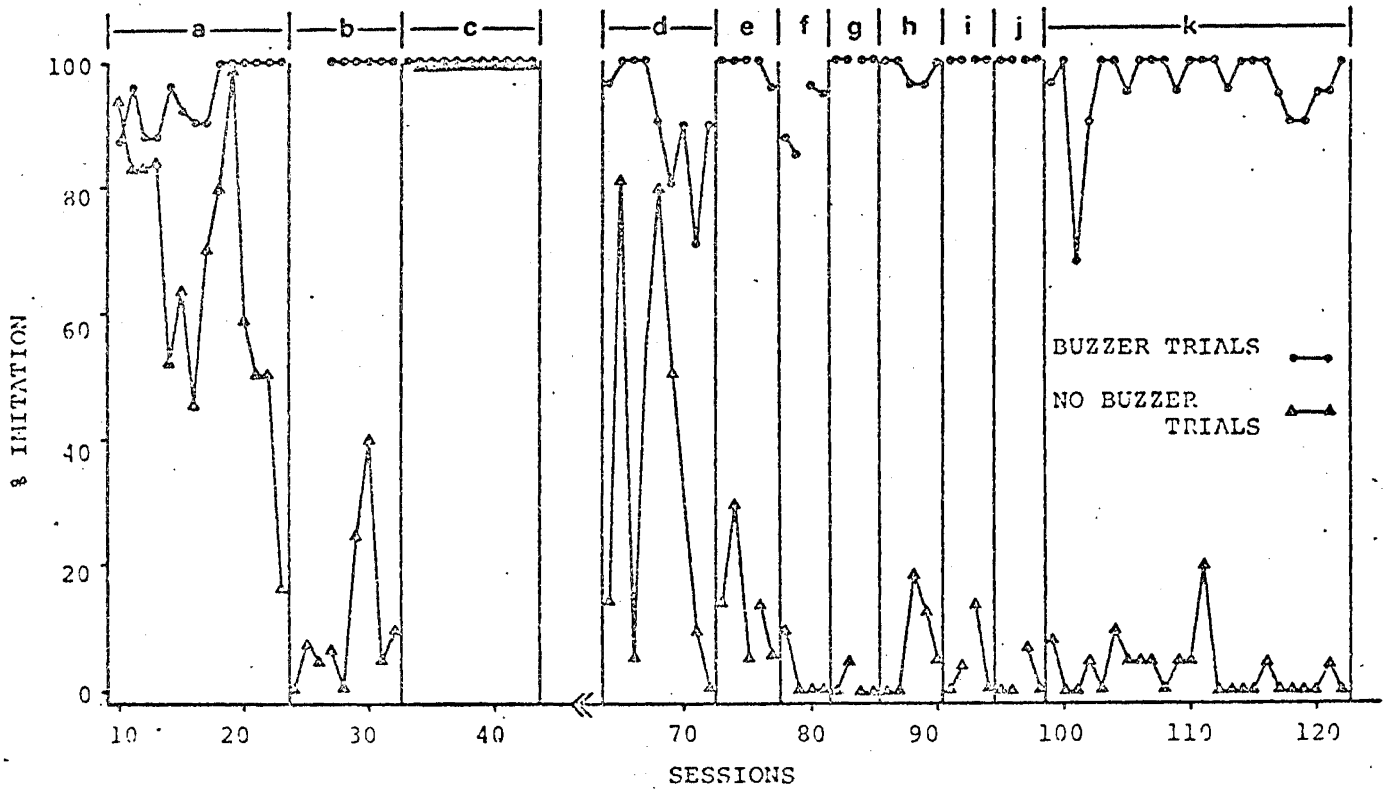

FIGURE 5 Percent imitation on S+ (buzzer) and S- (no buzzer) trials for Subject 1 in Experiment 1. Divisions correspond with introduction of new responses as follows: (a) responses 1 and 2; (b) 1; (c) 3; (d) 4; (e) 5; (f) 6; (g) 7; (h) reintroduction of 1, 2 and 3; (i) 8; (j) 9; (k) 10 up to 40. In e through j curves before the break show percent imitation of the new response alone and curves after the break show percent imitation of all previously introduced responses when trials for the new imitation were interspersed among trials for previously established imitations. Data for Sessions 44-63 are presented in an appendix.

procedure. These procedures did not eliminate the emission of the incorrect alternative on S- trials. Section c shows S+ and S- trial percent imitation when a response with no convenient incorrect alternative (nod yes) was introduced. Imitation occurred on 100 percent of S+ and S- trials. The problem of S- trial responding was eliminated during Sessions 44-64. The additional discrimination training, involving use of a physically difficult to imitate response and a shaping procedure, and the results, are descirbed in the appendix.

Section d shows the results obtained during reinstatement of the standard discrimination training procedure with response 4 which was used during the additional training procedures of sessions 44-64. The following sections e, f and g, where responses with no incorrect alternative to imitation available were introduced, show that the reduction of S- trial responding achieved with response 4 was carried over to responses 5, 6 and 7. When responses with incorrect alternatives to imitation available were again introduced, S- trial responding almost never recurred and the discrimination performance was well maintained (see sections h, i and j).

Section k shows that the discrimination criterion was met in all sessions except Session 101 during the phase where one or more new responses were introduced in all but Session 102. At the end of this training phase a stable stimulus controlled repertoire of 40 imitations had been established.

3.3.52 Subject 2

Figure 6 shows the results of discrimination

training for Subject 2. Section a shows results obtained when responses 1 and 2 were both included in discrimination training. No separation of S+ and S- training trial percent imitation developed.

Sections b to g inclusive show the improved discrimination performance when the standard procedure of discrimination training to criterion with each new imitation alone prior to inclusion of trials for the new imitation interspersed among trials for previously discrimination trained imitations was adopted. A problem during these sessions was that Subject 2 sometimes engaged in laughing for periods of a few seconds up to 10 minutes. A procedure conceptualised as time out combined with DRO 30 second, where the experimenter withdrew attention during laughing till 30 seconds of behaviour other than laughing was emitted, was used. The procedure appeared to keep laughing duration at an acceptably low level but no evaluation was conducted.

The curves following the break in section h show S+ and S- trial percent imitation when trials for imitation of response 7 were interspersed among trials for responses 1 to 6. During this phase the frequency and duration of the subjects observing-the-experimenter behaviour decreased, progress during sessions became slow, and the discrimination performance deteriorated. During Session 139 the experimenter said the subjects first name before each response demonstration expecting that this might improve the observing response and hence the discrimination performance. Percent imitation increased on both S+ and S- trials and procedure was discontinued. Other potential

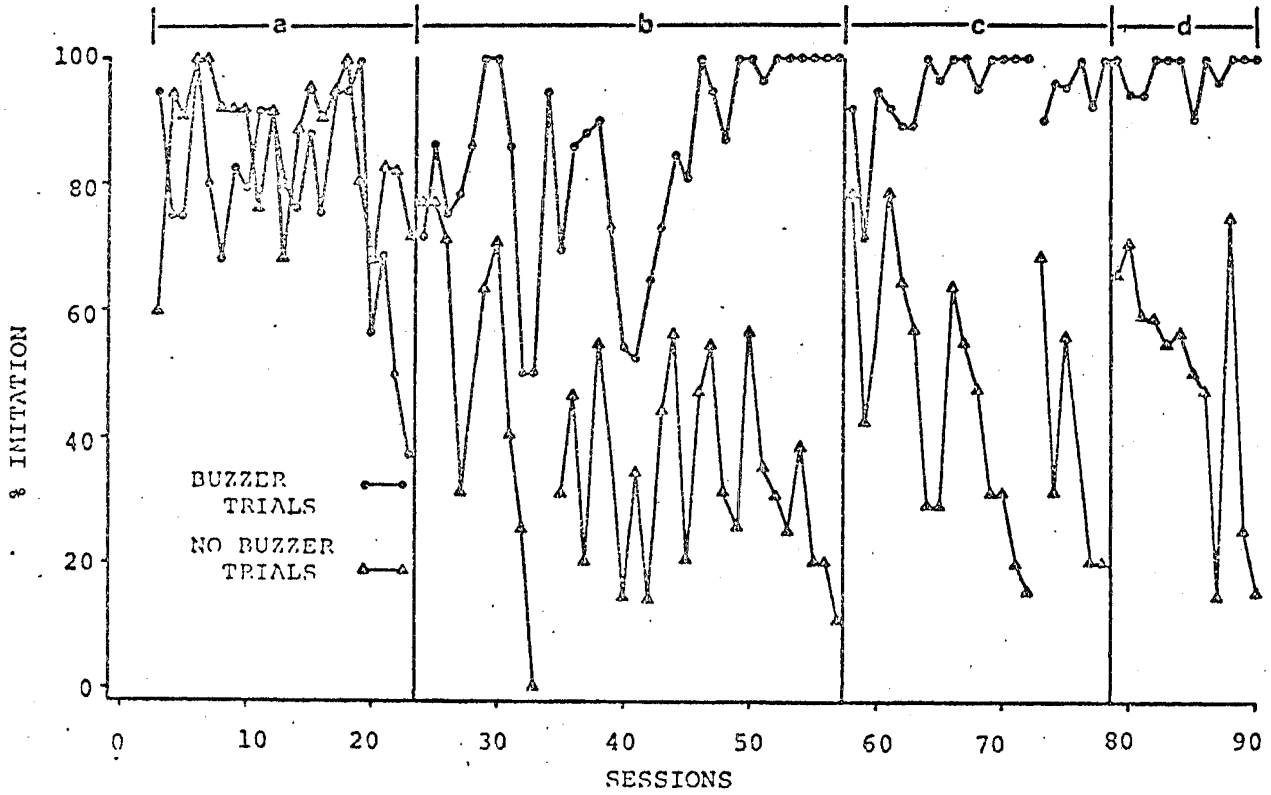

FIGURE 6 Percent imitation on S+ (buzzer) and S- (no buzzer) trials for Subject 2 in Experiment 1. Divisions correspond with introduction of new responses as follows: (a) responses 1 and 2; (b) 1; (c) 2; (d) 3; (e) 4; (f) 5; (g) 6; (h) 7. In c through h curves before the break show percent imitation of the new response alone and curves after the break show percent imitation of all previously introduced responses when trials for the new imitation were interspersed among trials for previously established imitations.

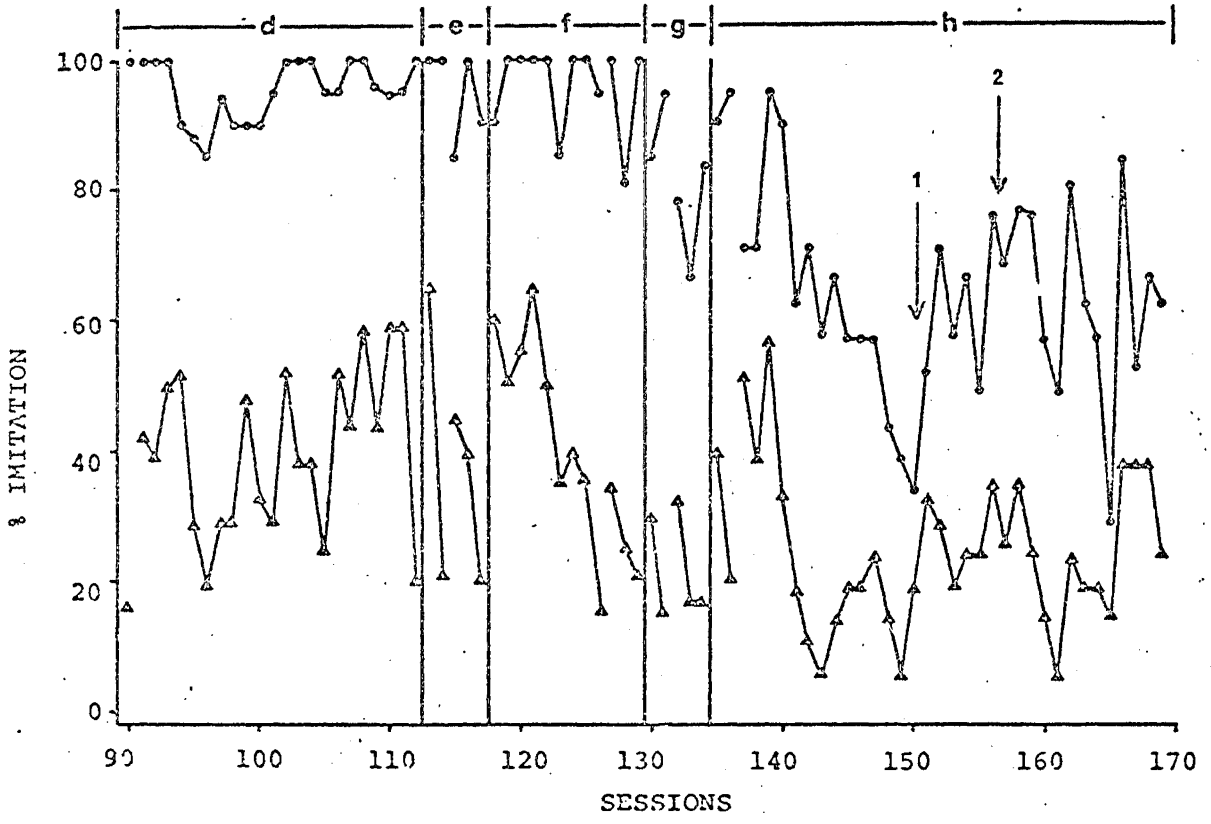

FIGURE 6 (continued) Arrows 1 and 2 indicate intervals between sessions of 15 and two weeks respectively.

reinforcer items were tried in Sessions 145, 146 (1 cm cubes of mild cheese), 147, 148 (saltanas), 149, 150 (chocolate buttons), and 165 (icecream) but no increase in S+ trial percent imitation occurred.

After Session 169 training of Subject 2 was discontinued because of the difficulty in establishing the required repertoire in the time and with the reinforcers available.

3.3.53 Subject 3

Figure 7 shows the results of discrimination training for Subject 3. Over section a imitations of response 1were brought under stimulus control reletively quickly. Section b shows the unsuccessful results of continued discrimination training intended to establish stimulus control of imitations of response 2.

During sessions in section b, Subject 3 emitted increasingly negative and violent behaviours. In Session 12 she announced a dislike of coming to the experimental room and in the following session dawdled and complained on the way to the room and on arrival stood by the dispenser with her back to the experimenter. From Session 14 on (see arrow 1) additional reinforcers (one cent pieces) on a variable ratio three (VR3) schedule were superimposed on the continuous reinforcement (CRF) schedule of sweets, contingent on S+ trial imitations in an attempt to reduce resistance to the experimental procedures. S+ trial percent imitation increased and the subject was more cooperative during Sessions 14 to 17.

During Session 18 the subject began shouting on S-

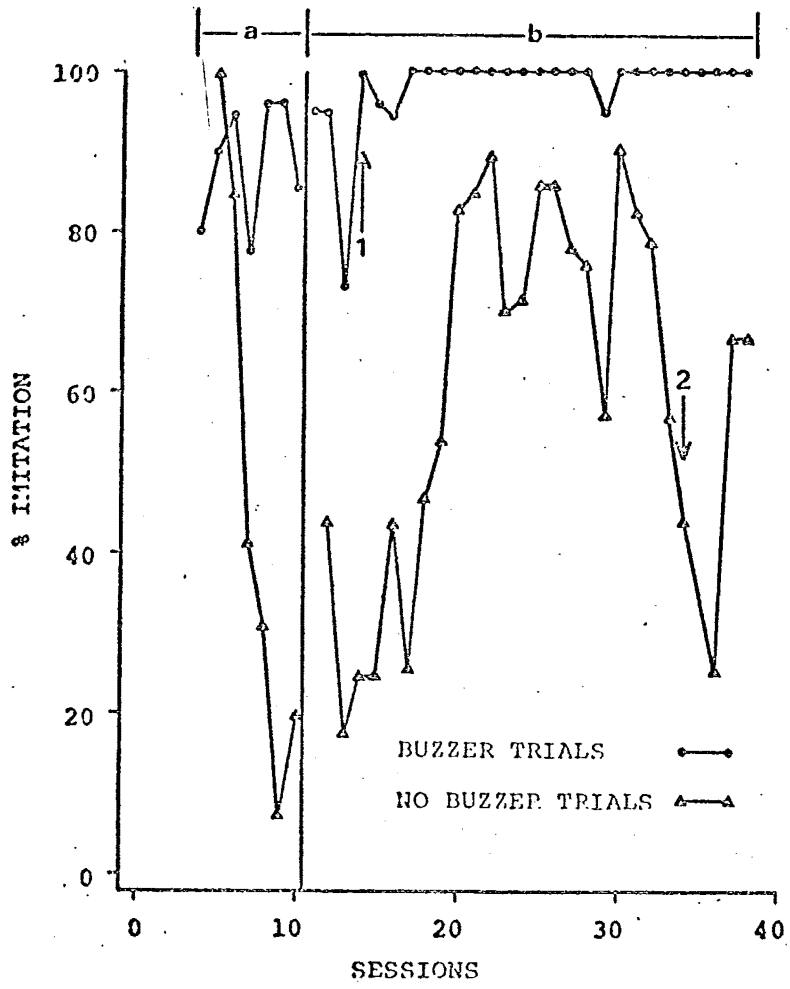

FIGURE 7 Percent imitation on S+(buzzer) and S-(no buzzer) trials for Subject 3 in Experiment 1. Divisions correspond with introduction of new responses as follows: (a) response 1; (b) 2. Arrows indicate: (1) introduction of additional monetry reinforcers contingent on S+ trial imitations; (2) introduction of time out contingent on S- trial imitations.

trials. Over the following sessions S- trial percent imitation increased and her behaviour on these trials became more violent. Over Sessions 34 to 38 a procedure conceptualised as time out combined with DRO 10 sec was used (see arrow 2). The experimenter withdrew attention contingent on S- trial imitations and violent behaviour and attended to the subject again after 10 seconds of other behaviour. There was no stable decrease in S- trial percent imitation or violent behaviour. Following several sessions during which Subject 3 violently struck the reinforcer dispenser training was discontinued.

3.3.54 Subject 4

Figure 8 shows the results of discrimination training for Subject 4, following Sessions 4 to 8 devoted to S+ trial training of imitation response 1.

On the basis of results of earlier pilot sessions difficulty was anticipated with discrimination training. At arrow 1 on Figure 8 an additional cue was provided on S- training trials. On these trials the experimenter did not hold the remote control switches for the dispenser and buzzer. During Session 19 (see arrow 2) this additional cue was faded out. On successive trials the experimenter held his hand progressively closer to the switches till he eventually held them in the same manner as for S+ training trials.

Percent imitation on S+ training trials often dropped below the 80 percent criterion. In Sessions 25 (see arrow 3) to 37 additional reinforcers (one cent pieces) on a VR3 schedule were superimposed on the CRF schedule of sweets

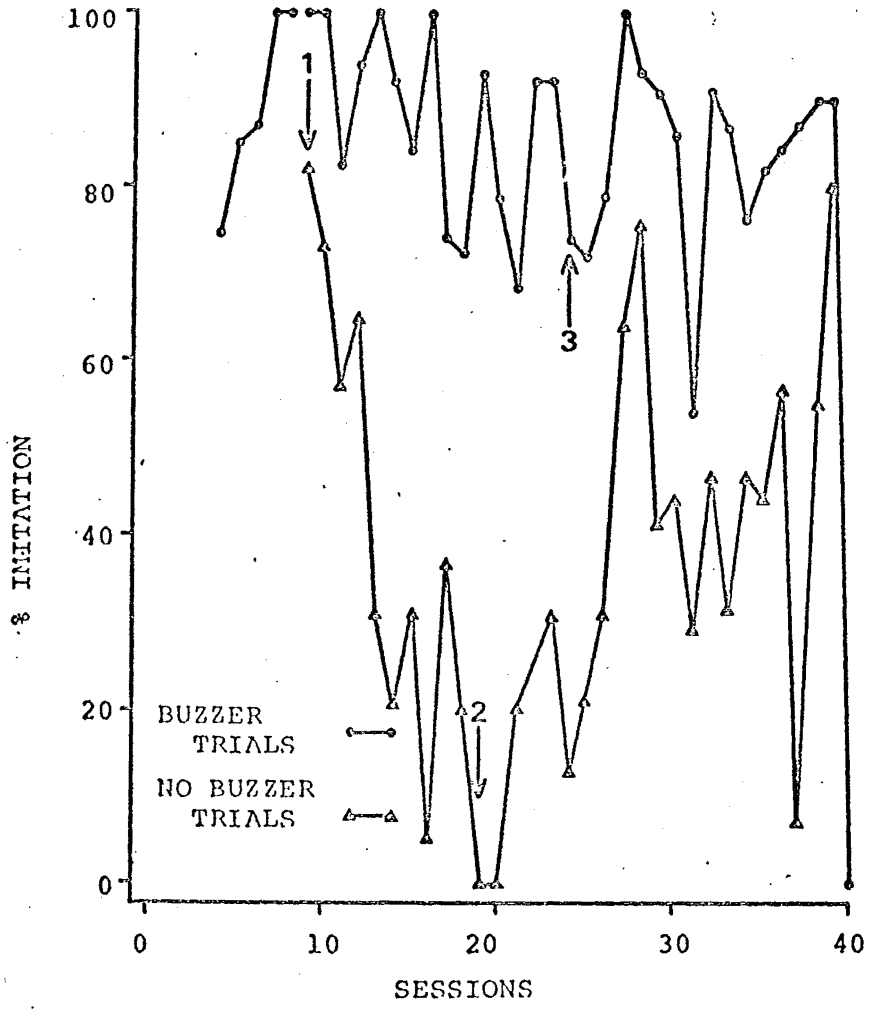

FIGURE 8 Percent imitation on S+ (buzzer) and S- (no buzzer) trials for Subject 4 in Experiment 1. The same response was demonstrated in all sessions. Arrows indicate: (1) and (2) introduction and fading out of an additional cue on S- trials; (3) introduction of additional monetry reinforcers contingent on S+ trial imitations.

contingent on S+ trial imitations in an attempt to strengthen this behaviour. No large increase in S+ trial imitation occurred though percent imitation on S- trials increased considerably.

As discrimination training proceded problems similar to those experienced with Subject 3 arose. Subject 4 began shouting "No!" and stamping her feet on some S- trials and in one session threw various objects about the room. Refusals to attend experimental sessions increased and in Session 40 after entering the experimental room protesting the subject did not imitate on any S+ trials and physically resisted attempts to re-establish imitation using physical guidance. Training with Subject 4 was discontinued during session 40.

3.3.55 Subject 5

Figure 9 shows the results of discrimination training for Subject 5. In the early sessions of section a S+ trial percent imitation was often lower than that for S- trials. At arrow 1, additional reinforcers (one cent pieces) contingent on S+ trial imitations on a VR4 schedule were superimposed on the standard CRF schedule for sweets. Percent imitation on S+ trials increased over the following sessions in section a.

Over sections b to i the discrimination criterion was achieved relatively quickly with each new response (see curves before the break in each section). With the exception of section b the discrimination criterion was quickly achieved again when trials for new imitations were interspersed among those for previously discrimination trained imitations (see curves following break in each section).

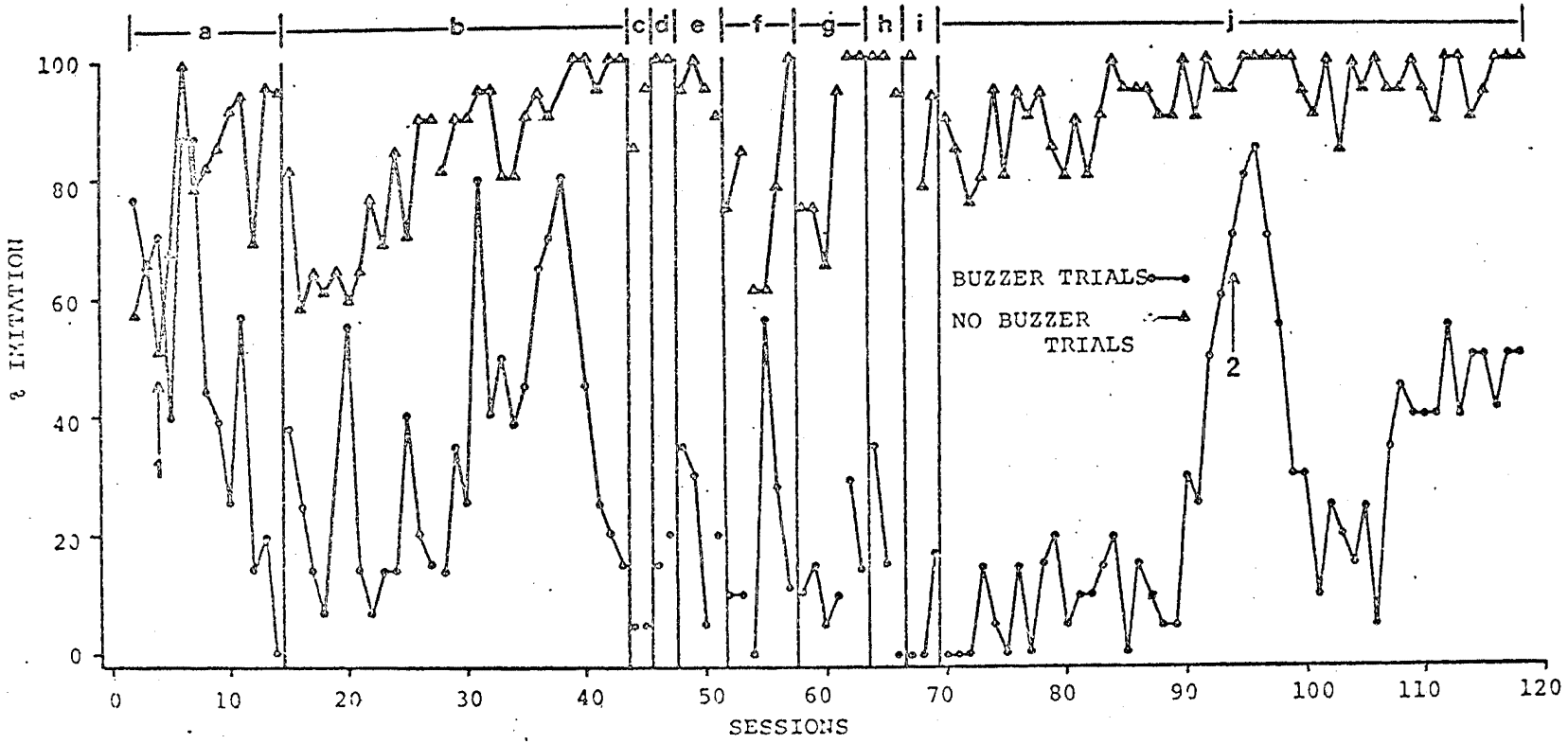

FIGURE 9 Percent imitation on S+ (no buzzer) and S- (buzzer) trials for Subject 5 in Experiment 1. Divisions correspond with introduction of new responses as follows: (a) response 1; (b) 2; (c) 3; (d) 4; (e) 5; (f) 6; (g) 7; (h) 8; (i) 9; (j) 10 up to 30. In b through i curves before the break show percent imitation of the new response alone and curves after the break show percent imitation of all previously introduced responses when trials for the new imitation were interspersed among trials for previously established imitations. Arrows indicate: (1) introduction of additional monetary reinforcers contingent on S+ trial imitations; (2) introduction of time out contingent on S- trial imitation.

Over Sessions 70 to 90 of section j the discrimination performance met the discrimination criterion in most sessions and new responses were introduced at a rate of about four every five sessions. From Session 90 on an increase in S- trial percent imitation occurred. In Session 94 (see arrow 2 in Figure 9 and arrow c in Figure 4) a procedure conceptualised as time out combined with DRO 10 sec was introduced. When S- trial imitations occurred the experimenter read a book till 10 seconds elapsed after the last imitation. A discrimination performance satisfying the criterion and enabling further responses to be introduced was re-established after eight sessions use of this procedure but this improvement was temporary (see Figure 9 and the second arrow b in Figure 4).

Over the last 20 sessions shown in Figure 9 Subject 5 began reacting adversely to S- trial presentations with increasing frequency and intensity. Initially she shouted "No!" and in later sessions also screamed and stamped her feet. Before the last three sessions she was reluctant to enter the experimental room. Because of this and the difficulty in decreasing S- trial percent imitation, training was discontinued.

3.4 DISCUSSION

The combination of physical guidance, prompting, fading, shaping and positive reinforcement procedures was effective in training all subjects to imitate on S+ trials. Subjects who learned only a small number of imitations never-the-less acquired these relatively quickly. As the

number of imitations acquired increased, generally fewer trials were required to establish new S+ trial imitations (Subjects 1, 2 and 5) and imitation of new responses on their first S+ trial demonstration became more frequent (Subjects 1 and 5). The effectiveness of the imitation training procedures and the subsequent accelerated acquisition of new imitations - one aspect of generalised imitation - is consistent with results reported by other authors (Baer et al., 1967; Berkowitz, 1969; Bry and Nawas, 1972; Garcia et al., 1971; Hingten et al., 1967; Lovaas et al., 1966; Lovaas et al., 1967; Metz, 1965; Peterson, 1966; Streifel and Phelan, 1972; Whalen and Henker, 1971; Williams, 1971).

The discrimination training procedures were less effective. Only three subjects acquired a stimulus controlled repertoire including five or more different imitations and ultimately the repertoire remained stable for only one of these subjects. Never-the-less these results to some extent replicate those of reported by Williams (1971) which showed that such a repertoire could be established using differential reinforcement for stimulus control procedures. Steinman (1970b) reported an unsuccessful attempt to produce a similar repertoire with normal children.

Once stimulus control of a small number of imitations had been established the discrimination performance remained relatively stable for the remainder of the experiment for Subject 1 and till following the introduction of the twentyfifth response in Session 90 for Subject 5 (see Figures 4 and 9). As the number of imitations acquired and included in discrimination training sessions increased over this period

not only did the frequency of first S+ trial imitations of new responses increase but the frequency of first S- trial imitations of the same new responses decreased. That is, the first demonstrations of new responses accompanied by stimulus conditions which had been an antecedent for other reinforced imitations were frequently imitated, while the first demonstrations of the same new responses accompanied by stimulus conditions which had been an antecedent for other unreinforced imitations were infrequently imitated.

These results could not be attributed to the order of first demonstration of new responses with respect to S+ and S- trials since possible order effects were controlled for by alternation for responses numbered 11 and greater (see first demonstration column in Tables 5 and 8). Nor could the results be attributed to any supposed facilitative or inhibitory effects exerted by the buzzer or its absence per se, since the S+ and S- for Subject 1 were the presence and absence of the buzzer while the reverse arrangement was used with Subject 5. However, since the differential reinforcement variable was not manipulated, no evidence was provided relating to the question of whether a functional relationship existed between the control of new and maintained imitations exerted by the S+ and the differential reinforcement of imitations preceeded by this stimulus.

Stimulus control was not established with Subjects 3 and 4 and the stimulus control established with Subjects 2 and 5 was ultimately unstable. Other authors (Burgess et al., 1970; Peterson and Whitehurst, 1971; Steinman, 1970b; Steinman and Boyce, 1971) have noted the difficulty sometimes experienced in attempting to decrease the frequency of imitation (usually for the purposes of functional analysis)

using extinction or DRO procedures. Steinman has reported evidence that explicit or implicit experimenter instructions may over ride the effects of experimental contingencies and Peterson has found that experimenter presence increases the frequency of unreinforced imitations. Possibly the behaviour of Subjects 3 and 4 was influenced by setting factors of this type.

The sudden loss of stimulus control with Subject 5 after about 50 sessions of discrimination performance at or near criterion level was not traceable to any particular event. However it seemed possible this was related to between session communication with Subject 3 whose disruptive and non-compliant behaviour during experimental sessions had become difficult to control at about the same time.

The loss of stimulus control with Subject 2 differed from that with Subject 5 in that it involved a decrease in S+ trial imitation rather than an increase in S- trial imitation. Possibly this reflected a loss of reinforcer potency though other potential reinforcers were tried without appreciable effect.

Another feature of interest was the resistant and sometimes aggressive behaviour displayed by Subjects 3, 4 and 5. Though no data were collected, violent and aggressive behaviours were clearly more frequent directly following presentation of S- trials. This may have been an example of extinction induced aggression of the type reported by Azrin, Hutchinson and Hake (1966). Certainly, there appeared to be no decrease in frequency or intensity of the behaviour despite every effort to ensure that any potential

reinforcer was withheld which seems to support interpretation in terms of an elecitation process. Interestingly Berkowitz (1969) and Williams (1971) also reported the occurrence of similar "emotional" behaviour though they did not note any relationship between the emission of this behaviour and the use of extinction procedures.

In summary, a stable stimulus controlled imitative repertoire such that imitation occurred when response demonstrations were accompanied by the buzzer, but did not occur when demonstrations of the same responses were not accompanied by the buzzer was established with one of five developmentally retarded subjects. The repertoire was generative in that when new responses which the subject had not been trained to imitate were demonstrated, they also were imitated or not imitated depending on whether the buzzer was present or absent respectively.

CHAPTER IV

EXPERIMENT 2: STIMULUS CONTROL OF REINFORCED AND UNREINFORCED IMITATIONS

4.1 INTRODUCTION

In Experiment 1 a stable repertoire consisting of a set of imitations of diverse topographies, the emission and non-emission of which was controlled by the presence and absence respectively of an arbitrary stimulus following response demonstrations, was established with one of the five subjects. This second experiment was to investigate whether the emission of unreinforced imitations of new response demonstrations (probe responses) presented on interspersed probe trials would be similarly controlled. If stable stimulus control of training trial imitations (differentially reinforced on S+ training trials) and of probe trial imitations (unreinforced on S+ and S- probe trials) was maintained, then a further manipulation was planned to investigate whether such control could be described in terms of a functional relationship between the differential reinforcement of S+ training trial imitations and emission of reinforced and unreinforced imitations on S+ training and probe trials respectively and non-emission of imitations of training and probe responses on S- trials.

Since this experiment was concerned with a functional analysis of stimulus control within each of two sets of imitations (i.e. training and probe sets) through the application of a differential reinforcement for stimulus

control contingency to one of the sets (i.e. training set), a reversal of this contingency within this set was considered a more appropriate procedure than the extinction or DRO procedures used in most other studies of unreinforced imitations (e.g. Baer et al., 1967; Burgess et al., 1970).

Since the results of this reversal were rendered ambiguous by a differential decrease of S+ probe trial imitation, the experiment was extended to repeat the reversal under altered conditions using a second set of probe responses. Following the first reversal the second set of probe responses was introduced for 10 sessions and then withdrawn. A second reversal was conducted for imitations of the training set of responses without including trials for imitation of probe responses. The first set of probe responses was then re-introduced for five sessions and then withdrawn. After 10 more sessions without probe trials the second set of probe responses was re-introduced for 14 sessions.

4.2 METHOD

4.2.1 Subject and Setting

Only one subject, Subject 1 from Experiment 1, was used as she was the only child who acquired the prerequisite repertoire for this experiment. The setting was the same as for Experiment 1.

4.2.2 General Procedure

The general procedure was essentially the same as that described in the method sections 3.2.3, 3.2.5, 3.2.7, 3.2.8 and 3.2.93 for Experiment 1. Specific changes in

conditions during the experiment are elaborated in the following section.

4.2.3 Experimental Conditions

An outline of the 10 experimental phases is shown in Table 10.

4.2.31 Phase 1. Sessions 123-127

This phase was essentially a continuation of the procedures used with Subject 1 during sessions in section k on Figure 5 in Experiment 1. However no new training responses were introduced during this phase which was conducted to obtain a reference phase to enable evaluation of the effects of the introduction of probe trials for unreinforced imitations in Phase 2.

Each session included demonstrations of 20 different training responses which were randomly selected anew for each session from the pool of 40 responses to which imitations were trained in Experiment 1 (see Table 5). Sessions consisted of 40 trials (plus correction trials where necessary) and the 20 responses were quasi-randomly assigned to these trials in one block with the restraints that,

(1) each response was demonstrated once on an S+ trial and once on an S- trial, and

(2) no more than two consecutive S+ or S- trials were allowed. As in section k of Experiment 1, imitations emitted on buzzer (S+) trials were reinforced while those emitted on no buzzer (S-) trials were not.

4.2.32 Phase 2. Sessions 128-135

The organisation of sessions was essentially the same as for Phase 1 in that 20 responses were demonstrated

over 40 trials quasi-randomly assigned, and training responses were randomly selected anew for each session. Training trials were conducted as before.

Now, however one or more of the 20 responses was a newly introduced response demonstrated once on an S+ and once on an S- probe trial. Probe trials differed from training trials in that,

(1) S+ probe trial imitations were not reinforced,

(2) recording of S+ probe trial imitations was delayed till 10 seconds following the last imitation emitted and

(3) the correction trials procedure was not used.

Each probe response was included in only one session. Initially probe responses were introduced at the rate of one per session but this was increased by no more than one additional probe response per session till in session 135 five were introduced (see Table 11). The order of demonstration of new probe responses with respect to S+ and S- probe trials was alternated so that odd numbered responses were first demonstrated on an S+ probe trial followed by a demonstration on an S- probe trial later in the same session and vice versa for even numbered responses (see Table 11).

4.2.33 Phase 3. Sessions 136-150

Each session included demonstrations of 21 responses. Fifteen training responses were randomly selected anew for each session from the responses numbered 1 to 40. Six probe responses designated P1,1 to P1,6 (see Table 11) were randomly selected from responses numbered 41 to 61 excluding numbers 48 and 60 which were not imitated

TABLE 10

The sequence of experimental conditions in Experiment 2.

Phase	Sessions	Number and Type of Responses Used		Experimental Stimuli	
		Training Responses	Probe Responses	S+	S-
1	123-127	20	0	buzzer	no buzzer
2	128-135	19 decreased to 15	1 increased to 5	buzzer	no buzzer
3	136-150	15	6(P1 set)	buzzer	no buzzer
4	151-177	15	6(P1 set)	no buzzer	buzzer
5	178-187	15	6(P2 set)	no buzzer	buzzer
6	188	20	0	no buzzer	buzzer
7	189-193	20	0	buzzer	no buzzer
8	194-198	15	6(P1 set)	buzzer	no buzzer
9	199-208	20	0	buzzer	no buzzer
10	209-222	15	6(P2 set)	buzzer	no buzzer

TABLE 11

The sequence of new response demonstrations introduced on probe trials during Phase 2 of Experiment 2. Imitations of these responses were not reinforced. The symbols + and - show whether the response was first demonstrated in the context of an S+ or S- probe trial respectively. Probe numbers designate responses selected as members of the P1 and P2 sets of probe responses used in Phases 3, 4 and 8, and 5 and 10 respectively.

Response Number	Response Description	First Demonstration	Session Introduced	Probe Number
41	Put hat on chair	+	128	P1,1
42	Tap wall	-	129	P1,2
43	Forehead touches table top	+	130	P2,1
44	Sit on floor	-	130	
45	Jump (both feet off floor)	+	131	P1,3
46	Draw a circle	-	131	
47	Cut paper with scissors	+	132	
48	Open and close scissors	-	132	
49	Open and close book	+	132	P2,3
50	Put block in box	-	133	
51	Clap hands	+	133	P1,4
52	Put rubber band over door knob	-	133	P2,4
53	Open file drawer	+	134	P2,2
54	Open window	-	134	
55	Tap chair with pencil	+	134	P1,5
56	Tap spoon on table	-	134	P2,5
57	Hands on back of neck	+	135	P2,6
58	Crumple up paper	-	135	
59	Nest three boxes	+	135	P1,6
60	Staple paper	-	135	
61	Take book from shelf	+	135	

during Phase 2, and number 46 with which imitation had been inadvertantly reinforced. The same six probe responses were included in all sessions.

Responses were quasi-randomly assigned to the 42 trials in one block as before with the additional restraints that;

(1) consecutive probe trials were always separated by at least one training trial;

(2) no more than two consecutive S+ or S- probe trials occurred and

(3) the same probe response was not demonstrated on consecutive probe trials.

Training and probe trials were conducted as in Phase 2.

4.2.34 Phase 4. Sessions 151-177

All conditions except the reinforcement contingenies for training trial imitations remained the same as for Phase 3. The reinforcement contingencies for training trial imitations were reversed so that imitations emitted on "no buzzer" training trials were now reinforced and imitations emitted on "buzzer" training trials were no longer reinforced. That is the S+ and S- were now the absence and presence respectively of the buzzer following response demonstrations.

4.2.35 Phase 5. Sessions 178-187

The six probe responses used in Phases 3 and 4 were replaced by 6 new probe responses designated P2,1 to P2,6, randomly selected from the remaining responses numbered 41 to 61 excluding numbers 46, 48 and 60. All other conditions remained the same as in Phase 4.

4.2.36 Phase 6. Session 188

Conditions were the same as those for Phase 1 except that the reinforcement contingency for training trial imitations remained the same as for Phases 4 and 5. This single session was included to provide a reference phase for evaluation of changed conditions in Phase 7.

4.2.37 Phase 7. Sessions 189-193

All conditions except the reinforcement contingencies for training trial imitations remained the same as for Phase 6. The reinforcement contingencies for training trial imitations were again reversed so that imitations emitted on "buzzer" (now S+) trials were reinforced and imitations emitted on "no buzzer" (now S-) trials were no longer reinforced. All conditions were the same as those for Phase 1 where no probe trials were presented.

4.2.38 Phase 8. Sessions 194-198

Probe trials involving demonstrations of the P1 set of probe responses were reintroduced and the other conditions of Phase 3 prior to the first reversal were reinstated. An additional control procedure was introduced in the last two sessions to determine whether the subject was observing the S- trial response demonstrations which she usually did not imitate. On the S- training trials closest to trials numbered 10, 20, 30 and 40 (not counting correction trials) where no imitation was emitted, the buzzer (S+ for this phase) was presented at the end of the 10 second opportunity to imitate period and a further 10 second opportunity provided.

4.2.39 Phase 9. Sessions 199-208

Discrimination training was continued but no probe trials were presented. Conditions were the same as those for Phases 1 and 7 with the exception that the S- training trial control procedure introduced in the last two sessions of Phase 8 was continued.

4.2.3 10 Phase 10. Sessions 209-222

Probe trials involving demonstrations of the P2 set of probe responses previously used in Phase 5 were reintroduced. All other conditions except the reinforcement contingencies for training trial imitations were also the same as those for Phase 5. The reinforcement contingencies were the same as those in Phases 7, 8 and 9. Only "buzzer" (S+) training trial imitations were reinforced whereas in Phase 5 only "no buzzer" training trial imitations were reinforced.

4.3 RESULTS

The major results of the experiment are shown in Figure 10.

4.3.1 Training Trials

4.3.11 Phase 1. Sessions 123-127

The mean percent imitation was 97 percent (range 95-100 percent) and 2 percent (range 0-5 percent) for S+ and S- training trials respectively.

4.3.12 Phase 2. Sessions 128-135

The introduction of one to five new probe responses per session did not disrupt the training trials discrimination.

The mean percent imitation was 96 percent (range 89-100 percent) and 0 percent for S+ and S- training trials respectively.

4.3.13 Phase 3. Sessions 136-150

The clear separation of percent imitation for S+ and S- training trials was maintained when the repertoire was probed with demonstrations of the same six members of the P1 set of probe responses. The mean percent imitation was 96 percent (range 93-100 percent) and 0 percent for S+ and S- training trials respectively.

4.3.14 Phase 4. Sessions 151-177

When the reinforcement contingencies for training trial imitations were reversed, behavioural reversal occurred rapidly. The discrimination criterion (80 percent or more imitation on S+ trials and 20 percent or less imitation on S- trials) was met in the fourth reversal session. The increase in percent imitation following the new S+ (absence of buzzer) occurred more rapidly than did the decrease in percent imitation following the new S- (buzzer). The mean percent imitation for sessions including and following the first achievement of the discrimination criterion (Sessions 154-177) was 92 percent (range 73-100 percent) and 6 percent (range 0-27 percent) for S+ and S- training trials respectively

4.3.15 Phase 5. Sessions 178-187

The training trials discrimination performance was not disrupted when the P1 set of probe responses was replaced by the P2 set. The mean percent imitation was 96 percent (range 87-100 percent) and 1 percent (range 0-7

percent) for S+ and S- training trials respectively. Comparison of the percent imitation ranges with those of Phase 4 shows an improvement in the stability of the disrimination performance associated with continued discrimination training under the reversed reinforcement contingencies condition.

4.3.16 Phase 6. Session 188

No change resulted from the removal of probe trials in session 188. The percent imitation was 95 percent and 0 percent for S+ and S- training trials respectively.

4.3.17 Phase 7. Sessions 90-100

When the second reversal of the reinforcement contingencies for training trial imitations was conducted, this time in the absence of probe trials, the behavioural reversal occurred more quickly than on the first reversal. The discrimination criterion was met in the second reversal session. As in the first reversal, percent imitation on S+ training trials increased more rapidly than it decreased on S- training trials. The mean percent imitation for sessions including and following the first achievement of the discrimination criterion (Sessions 190-193) was 99 percent (range 95-100 percent) and 3 percent (range 0-5 percent).

4.3.18 Phase 8. Sessions 194-198

The reintroduction of probe trials involving demonstrations of the P1 set of probe responses did not disrupt the reversed training trials discrimination performance established in Phase 7. The mean percent imitation was 99 percent (range 93-100 percent) and 4 percent (range 0-7 percent) for S+ and S- training trials respectively.

4.3.19 Phase 9. Sessions 199-208

There was no disruption of the training trials discrimination performance when probe trials were again removed though the data were slightly less stable. The mean percent imitation was 94 percent (range 85-100 percent) and 1 percent (range 0-5 percent) for S+ and S- training trials respectively.

4.3.1 10 Phase 10. Sessions 209-222

Again no disruption of the training trials discrimination performance occurred when probe trials, this time involving demonstrations of the P2 set of probe responses, were reintroduced. The mean percent imitation was 98 percent (range 93-100 percent) and 0 percent for S+ and S- training trials respectively.

4.3.2 S- Training Trial Control Procedure

The S- training trial control procedure was conducted on 48 S- training trials in all during Sessions 197-208. On two of these trials (approximately 4 percent) an imitation was emitted during the 10 second opportunity following the response demonstration and before presentation of the buzzer. An imitation was emitted on 44 of these trials (approximately 92 percent) during the 10 second opportunity immediately following presentation of the buzzer.

4.3.3 Probe Trials

4.3.31 Phase 2. Sessions 128-135

Twenty-one new probe responses were demonstrated, once on an S+ and once on an S- probe trial. Nineteen of these responses (approximately 90 percent) were imitated on

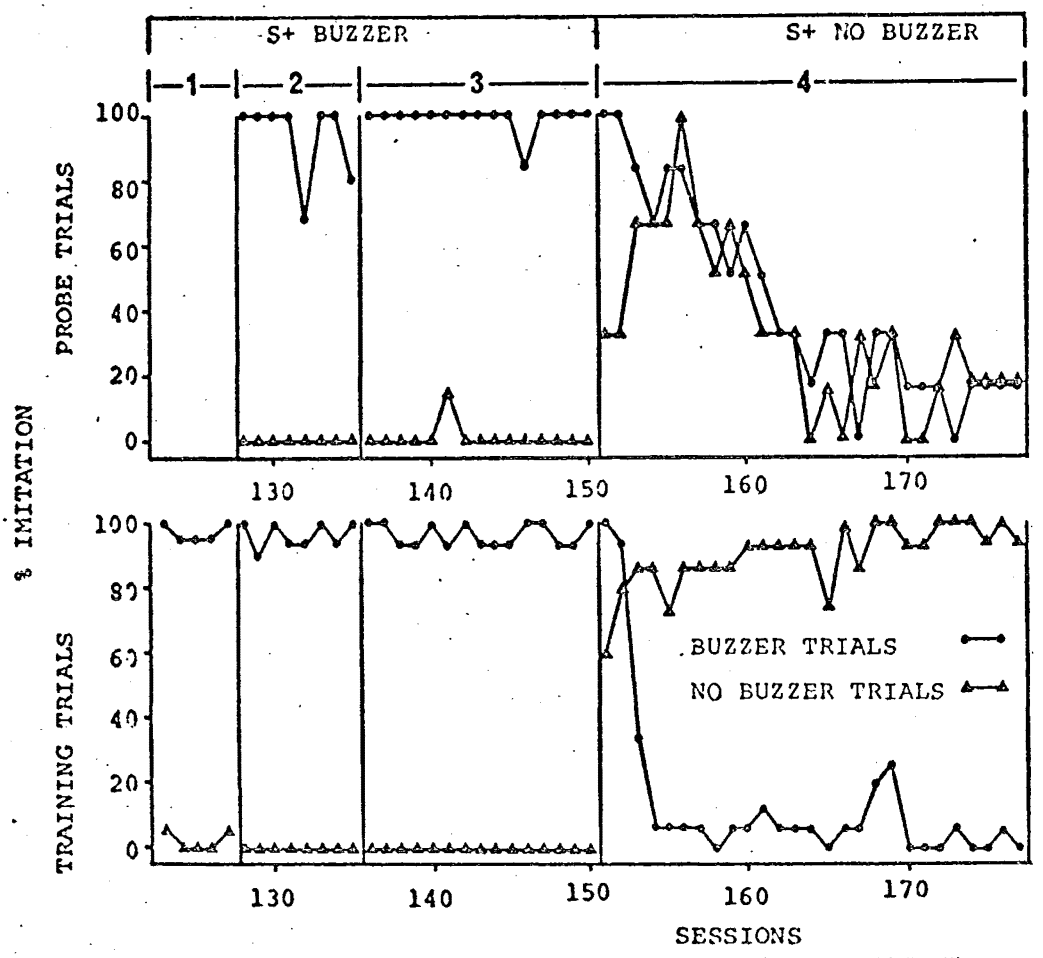

FIGURE 10 Percent imitation on S+ training trials (imitations reinforced), S- training trials, S+ and S- probe trials (imitations not reinforced), for Subject 1 in Experiment 2. Changes in the antecedent stimulus for reinforced training trial imitations (S+) associated with reversals of reinforcement contingencies for training trial imitations are shown at the top of the figure. The P1 set of probe responses was used for probe trials in Phases 3, 4 and 8 and the P2 set was used in Phases 5 and 10 (see Table 11). Other changes in experimental conditions are shown in Table 10.

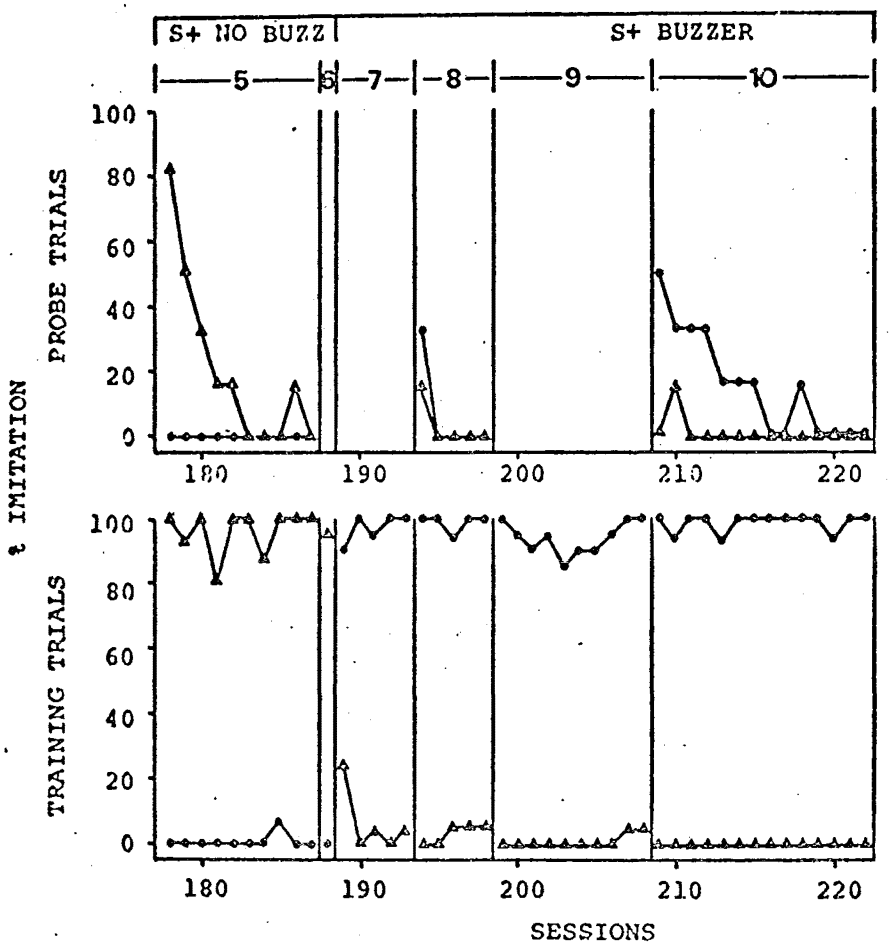

FIGURE 10 continued.

their first S+ probe trial demonstration. None were imitated in their first S- probe trial demonstration. The S+ probe trial imitation of response number 46 was inadvertently reinforced so this response was not used for any further probe trials.

4.3.32 Phase 3. Sessions 136-150

When the same six probe responses of the P1 set were demonstrated twice in each session the separation of percent imitation for S+ and S- probe trials was maintained. The mean percent imitation was 99 percent (range 83-100 percent) and 1 percent (range 0-17 percent) for S+ and S- probe trials respectively.

4.3.33 Phase 4. Sessions 151-177

When the reinforcement contingencies for training trial imitations were reversed, a corresponding behavioural reversal was not obtained on the probe trials. Percent imitation on the new S- (buzzer) probe trials decreased much more slowly than on S- training trials, requiring 17 reversal sessions to reach the 20 percent criterion in comparison with four sessions required for S- training trials. Initially percent imitation on the new S+ (no buzzer) probe trials did increase, from 0 percent in the last session before reversal to meet the 80 percent criterion in the sixth reversal session. Again this change was slower for S+ probe trials than for S+ training trials where the criterion was met in four sessions. Following this initial increase, percent imitation on S+ probe trials decreased and no real separation of percent imitation for S+ and S- probe trials was apparent. The mean percent imitation for sessions including and following the first achievement of the discrim-

ination criteria for training trials (Sessions 154-177) was 36 percent (range 0-83 percent) and 32 percent (range 0-100 percent) for S+ and S- probe trials respectively.

4.3.34 Phase 5. Sessions 178-187

When the P1 set of probe responses was replaced by the P2 set, imitation occurred on 83 percent of S+ probe trials and on 0 percent of S- probe trials in the first session. However percent imitation on S+ probe trials then decreased rapidly to values of 0 percent and 17 percent over the last six sessions. The mean percent imitation was 22 percent (range 0-83 percent) and 0 percent for S+ and S- probe trials respectively.

4.3.35 Phase 8. Sessions 194-198

In the first session of the reintroduction of P2 set of probe responses following the second reversal of reinforcement contingencies for training trial imitations, imitations were emitted on 33 percent and 17 percent of the S+ and S- probe trials respectively. No imitation occurred on S+ or S- probe trials during the remaining four sessions of this phase.

4.3.36 Phase 10. Sessions 209-222

Initially a small but directionaly appropriate separation of percent imitation on S+ and S- probe trials was obtained when the P2 set of probe responses was reintroduced. This disappeared when percent imitation on S+ probe trials decreased to 0 percent over the last four sessions. The mean percent imitation was 16 percent (range 0-50 percent) and 1 percent (range 0-17 percent) for S+ and S- probe trials respectively. Table 12 shows a comparison of these results with those obtained using the same probe

TABLE 12

Mean percent imitation of training and probe response demonstrations on "buzzer" and "no buzzer" trials for Subject 1 during Phases 5 (10 sessions) and 10 (14 sessions) of Experiment 2. During Phases 5 and 10 imitations of training responses were differentially reinforced on "no buzzer" and "buzzer" trials respectively. Imitations of probe responses were never reinforced.

Phase	"Buzzer" Trials		"No Buzzer" Trials	
	Training	Probe	Training	Probe
Phase 5	1%	0%	96%	22%
Phase 10	98%	16%	0%	1%

responses in Phase 5 where the reinforcement contingencies for training trial imitations were reversed with respect to those in Phase 10.

4.4 DISCUSSION

When the reinforcement contingencies for training trial imitations were reversed, the direction of the clear separation between percent imitation on "buzzer" and "no buzzer" training trials (mean separation never less than 86 percent in pre- and post-reversal sessions) was rapidly reversed on both occassions (see Figure 10, Phases 3, 4, 6 and 7). The rapidity of the behavioural reversals probably resulted from the continued use of the correction procedure following "incorrect" training trial outcomes. This ensured early contact with the reversed contingencies. These results show that emission of imitations on training trials was controlled by an element of the compound stimulus presented on imitation trials (viz. either the presence or absence of the buzzer following response demonstrations) which was an antecedent for reinforced training trial imitations. Moreover, the controlling properties of this stimulus element were functionally related to the differential reinforcement contingency in which it was included.

One area of uncertainty was the locus of stimulus control of appropriate non-imitation on S- training trials during phases where the S- was the absence of the buzzer. One possibility was that the experimenters behaviour before and/or during response demonstrations on S- training trials

differed from that on S+ training trials so that the non-availability of reinforcement was signalled and lead to the subject not attending to, or properly observing, the response demonstrations. The results of the S- training trials control procedure conducted in Phases 8 and 9 showed that appropriate non-imitation on S- training trials could not be accounted for in terms of the subjects failure to properly observe response demonstrations on those trials. Non-imitation appeared to be controlled by the absence of the buzzer.

When 21 new responses, imitations of which were not reinforced, were introduced as probes during Phase 2, 19 were imitated on their first S+ probe trial demonstration but none were imitated on their first S- probe trial demonstration. That is, the same new responses were imitated or not imitated dependent on the presence or absence respectively of the buzzer (S+), the presence of which was an antecedent for differentially reinforced imitations of a different (training) set of responses. This result could not be attributed to differences between the responses demonstrated on S+ and S- probe trials or to the order of the first S+ and S- probe trial demonstration of each new response. These potential influences were controlled for by demonstrating each response on both an S+ and an S- probe trial and by alternating the order of the first S+ and first S- probe trials for successive new responses. This result replicated that obtained during the introduction of training responses numbered 10 to 40 with Subject 1 in Experiment 1.

When the same six responses of the P1 probe set were each demonstrated on one S+ and one S- probe trial in each of

the 15 sessions of Phase 3, unreinforced S+ probe trial imitation was maintained. That is generalised imitation was still found under conditions where the difficulty of discrimination between reinforced S+ training trials and unreinforced S+ probe trials was presumably reduced in comparison to Phase 2 where the probe responses used were changed each session. However in the absence of appropriate control procedures such as instructions not to emit unreinforced imitations or Steinmans (1970a, 1970b) choice presentation procedure, the subjects concurrent ability or inability to discriminate between the two sets of responses remained unknown. However some evidence of the subjects capacity to rapidly learn to respond differently to S+ training and probe trial response demonstrations was available from the Phase 5 S+ probe trial data. The P2 set of probe responses had been demonstrated only twice before during Phase 2, yet percent imitation on S+ probe trials decreased from 80 percent to zero in six sessions (see Figure 10, Phase 5).

While the Phase 3 probe trial data showed that emission of unreinforced imitations may be controlled by an antecedent stimulus included in the differential reinforcement contingency for S+ training trial imitations, it provided no direct evidence of a functional relationship between the control exerted by the stimulus and its inclusion in the contingency. The Phase 4 probe trial data obtained during and following the reversal of the differential reinforcement contingency for S+ training trial imitations provided only weak evidence of a functional relationship. Though percent

imitation increased on the new S+ (no buzzer) probe trials and decreased on the new S- (buzzer) probe trials over the first six reversal sessions, the former change was not maintained. When the P1 set of probe responses was reintroduced in Phase 8 following the second training trials contingency reversal in Phase 7, the probe trial data provided no evidence of a functional relationship between differential imitation of probe responses on S+ probe trials and the differential reinforcement of S+ training trial imitations.

However, probe trial data obtained during Phases 5 and 10 where the P2 set of probe responses was used, did provide evidence of such a functional relationship. Though the separation of percent imitation on S+ and S- probe trials was not large or stable during either phase (see Figure 10), it was in the same direction as that for S+ and S- training trials in both phases. The change in direction of the separation with respect to "buzzer" and "no buzzer" probe trials between Phases 5 and 10 was congruent with the change in direction for training trials. This demonstrated that the stimulus control of unreinforced imitations on S+ probe trials was dependent on the inclusion of the S+ trial stimulus (buzzer absence and presence in Phases 5 and 10 respectively) in the differential reinforcement contingency for S+ training trial imitations.

However, S+ probe trial imitation was not maintained so that it was not possible to definately show that generalised imitation in the sense of maintained emission of unreinforced imitations could be accounted for in terms of

this functional relationship. Never-the-less it seemed likely that the maintained S+ probe trial imitation found in Phase 3 was functionally related to the differential reinforcement contingency for S+ training trial imitations.

The failure to obtain maintained S+ probe trial imitation following the reversal in Phase 4 may have been related to differences between conditions for training and probe trials. One obvious difference in conditions was the differential reinforcement of S+ training trial imitations and the non-reinforcement of S+ probe trial imitations. Though this was a necessary feature of the experimental design, the degree of the difference could have been reduced by using an intermittent schedule of differential reinforcement of S+ training trial imitations. This solution was avoided at this stage since the results would have been less comparable with those of other studies of generalised imitation, none of which have employed intermittent schedules for training trial imitations. Another difference between training and probe trials was created by the procedure of randomly selecting the training responses to be used anew for each session while using the same six probe responses in each session.

The loss of S+ probe trial imitation during and following the reversal in Phase 4, suggested that this may have resulted from an interaction between differences in training and probe trial procedures and the reversal procedure. The use of a correction procedure following "incorrect" trial outcomes for training but not for probe trials may have been relevant. During Phase 3 the training trials discrim-

ination performance was well maintained and the subjects behaviour rarely came into contact with the correction procedure so that this potential difference between conditions for the two types of trials was minimised. However, during the first three reversal sessions in Phase 4 the correction procedure was frequently used so that the difference in conditions was accentuated.

The frequent correction trials for "incorrect" training trial outcomes and non-correction of "incorrect" probe trial outcomes together with the reversal involving a shift from buzzer presence to buzzer absence as the stimulus included as an antecedent in the differential reinforcement contingency for S+ training trial imitations, may have facilitated a shift in the locus of control of imitation frequency from the experimental stimulus to other stimuli. During Phase 3, imitation was controlled by the buzzer (S+) irrespective of whether a training or a probe response was demonstrated. In the second half of Phase 4, imitation appeared to be controlled specifically by demonstrations of training responses unaccompanied by the buzzer (S+ was buzzer absence in Phase 4). Alternatively it may have been that non-imitation was not only controlled by the buzzer(S-) but also by demonstrations of probe responses. Whichever of these was the case, it was clear that the topographies of the demonstrations of responses from the training and/or probe sets of responses had acquired controlling properties in relation to imitation frequency which were not present prior to the reversal. The use of the absence of a stimulus as the S+ in Phase 4 may have facilitated this partial shift

in the locus of stimulus control. However when the same set of probe responses was re-introduced during Phase 8 where the S+ was again the buzzer, S+ probe trial imitation almost never occurred. Apparently there was no simple relationship between the nature of the S+ and the frequency of S+ probe trial imitations.

The improved results obtained using the P2 set of probe responses also warrants comment. One factor which may have been important was that these responses were included in fewer sessions than those of the P1 set, so that there was less opportunity for complete extinction of S+ probe trial imitations. The non-inclusion of the P2 probe responses during the reversal sessions in Phase 7 and the continued post-reversal discrimination training conducted on training trials during Phases 8 and 9 before the re-introduction of the P2 probe responses in Phase 10 may also have contributed to the at least temporarily maintained non-zero percent imitation on S+ probe trials in the latter Phase.

In conclusion, this experiment provided evidence of a functional relationship between control of training trial imitations by the experimental stimulus and the inclusion of this stimulus in the differential reinforcement contingency for S+ training trial imitations. A similar, though unstable, functional relationship was found between the S+ training trial differential reinforcement contingency and the differential emission on S+ probe trials of unreinforced imitations which the subject had not been trained to perform. The experiment failed to provide direct evidence of such a functional relationship between the S+ training trial differential reinforcement contingency and the maintained

emission of unreinforced imitations. Examination of the results in relation to the procedures used suggested that such a relationship might be able to be demonstrated under different experimental conditions.

CHAPTER V

EXPERIMENT 3: STIMULUS CONTROL OF UNREINFORCED IMITATIONS WITH INCREASED SIMILARITY OF TRAINING AND PROBE TRIAL CONDITIONS

5.1 INTRODUCTION

Following completion of Experiment 2, 106 sessions were spent informally investigating experimental conditions which might enable a functional relationship between maintained imitation on S+ probe trials and differential reinforcement of S+ training trial imitations to be demonstrated. The main features of the investigation were, the use of an intermittent reinforcement schedule for S+ training trial imitations, discontinuation of the correction procedure on training trials, the introduction of two new sets of six probe responses accompanied by introduction of the same number of training responses to reduce their salience, two reversals of the training trials differential reinforcement contingency in the absence of probe trials, and reintroduction of the probe responses from the P1 and P2 sets under the new conditions.

No stronger evidence of a functional relationship between maintained stimulus control of probe trial imitations and differential reinforcement of S+ training trial imitations was obtained. Generally the results replicated those of Experiment 2 but with some differences which suggested that the investigation of stimulus control of generalised imitation was worth pursuing using modified

experimental conditions. In every phase which included probe trials, a directionally appropriate separation of percent imitation on S+ and S- probe trials was initially obtained though this was not always large. More S+ probe trial imitation was obtained when new probe responses were introduced gradually and accompanied by introduction of new training responses against a background of intermittent reinforcement of S+ training trial imitations and the use of a non-correction procedure for both training and probe trials, in comparison with the introduction of the P2 set of probe responses in Experiment 2. Both contingency reversals produced appropriate behavioural reversal on training trials and on probe trials when these were reintroduced. Decreases in S+ probe trial imitation occurred following reversals but a degree of directionally appropriate separation of percent imitation on S+ and S- probe trials was maintained over a greater number of sessions than for the P2 probe response set in Experiment 2. When the P1 set of probe responses was reintroduced during a phase where the buzzer was the S+, a directionally appropriate separation (mean separation of 33 percent) was maintained over four sessions which was considerably greater than that obtained in Phase 8 of Experiment 2 (mean separation of 3 percent) where the buzzer was also the S+.

On the basis of these results and those from Experiment 2 support was inferred for the idea that a reduction of differences between conditions for training and probe trials and the use of new sets of training and probe responses would be likely to increase the degree of maintained stimulus control of unreinforced imitations. Hence a further sequence

of experimental manipulations was planned for the same subject under conditions considered more optimal for demonstration of induced stimulus control of probe trial imitations and of a functional relationship between this control and the training trial reinforcement contingencies. To this end, new sets of 10 training and 10 probe responses were used and differences in conditions for training and probe trials were minimised. The only remaining difference in conditions was that S+ training trial imitations were intermittently reinforced while S+ probe trial imitations were not reinforced.

5.2 METHOD

5.2.1 Subject and Setting

Subject 1 from Experiments 1 and 2 was used. The setting was the same as for the previous experiments.

5.2.2 General Procedure

The general procedure was the same as that described in method sections 3.2.3 and 3.2.5 for Experiment 1. Specific changes in conditions during the experiment are described in the following section.

5.2.3 Experimental Conditions

Table 15 shows an outline of the sequence of experimental conditions.

5.2.31 Phase 1. Sessions 1-5

Twenty new responses were introduced during Session 1 (see Table 13) and used in each session for the duration of the experiment. Responses used previously were

TABLE 13

New response demonstrations used for Experiment 3. The symbols + and - show whether the response was first demonstrated in the context of an S+ or an S- trial respectively. Probe numbers designate members of the P5 set of probe responses. Imitations of probe response demonstrations were never reinforced.

Response Number	Response Description	First Demonstration	Probe Number
85	Wriggle fingers	+	
86	Uncork bottle	-	P5,1
87	Open Padawax container	-	
88	Open match box	+	P5,2
89	Rotate trunk	+	
90	Squeeze bulldog clip	-	P5,3
91	Raise glass to eye level	+	P5,4
92	Pin on lapel button	-	
93	Turn light off	+	
94	Rotate wrists	-	P5,5
95	Put pencil in sharpener	-	
96	Move peg to opposite end of pegboard	+	P5,6
97	Stub cigarette	-	P5,7
98	Click knob on ballpoint pen	-	
99	Unscrew bottle top	+	P5,8
100	Turn heater thermostat knob	-	
101	Rotate hands around each other	-	
102	Turn plank over	+	
103	Hands on hips	+	P5,9
104	Thread bead on string	-	P5,10

no longer used. Ten of the new responses were designated as training responses and 10 were designated as probe responses. No training procedures, other than response demonstration, were used to occassion imitation of new responses.

A non-correction procedure was used throughout the experiment so that sessions contained a constant number of trials. For each session in this and other phases, demonstrations of the 20 responses were quasi-randomly assigned to 40 trials with the following restraints:

(1) each response was demonstrated once on an S+ and once on an S- trial;

(2) demonstrations of the same response never occurred on consecutive trials;

(3) no more than two consecutive S+ or S- trials occurred;

(4) no more than two consecutive probe trials occurred.

During Session 1 an additional restraint was imposed on the order of the sequence of response demonstrations. An attempt was made to sequence these so that half of training and probe responses were first demonstrated on an S+ trial and the other half were first demonstrated on an S- trial. This was achieved for the probe response set, but four and six of the training responses were first demonstrated on S+ and S- training trials respectively.

The stimulus for S+ trials was a two second presentation of the buzzer following response demonstrations and the S- was the absence of the buzzer. S+ training trial imitations were reinforced on a VR3 schedule so that two or three reinforcers were delivered in each session. Imitations emitted on S- training trials, S+ and S- probe trials were not reinforced. These conditions, including the use of the

TABLE 14

Arranged events following emission or non-emission of imitations on S+ and S- training or probe trials.

Type of Trial	Behaviour	
	One or more imitations emitted within 10 sec.	No imitations emitted within 10 sec.
S+ Training Trials Reinforcement Scheduled.	(1) Immediate reinforcement of first imitation. Record result. Wait 10 sec. Proceed with next trial on list.	(2) Wait 10 sec. following trial presentation. Record result. Proceed with next trial on list.
S+ Training Trials Reinforcement not Scheduled.	(3) Wait 10 sec. following last imitation emitted. Record result. Proceed with next trial on list.	(4) Same as (2)
S- Training Trials	(5) Same as (3)	(6) Same as (2)
S+ and S- Probe Trials	(7) Same as (3)	(8) Same as (2)

TABLE 15

The sequence of experimental conditions in Experiment 3.

Phase	Sessions	Experimental Stimuli	
		S+	S-
1	1-5	Buzzer	No Buzzer
2	6-16	No Buzzer	Buzzer
3	17-30	Buzzer	No Buzzer

non-correction procedure for all trials, had been in effect over 24 sessions immediately preceeding Session 1 of this experiment. The arranged events for various trial outcomes are outlined in Table 14.

5.2.32 Phase 2. Sessions 6-16

The training trials reinforcement contingencies were reversed so that presentation of the buzzer was now S- and absence of the buzzer was S+. That is, imitations emitted on "no buzzer" training trials were differentially reinforced on a VR3 schedule. No prompts were used during the reversal. All other conditions were the same as for Phase 1. It was planned to continue Phase 2 conditions till either behavioural reversal was achieved on probe trials to a criterion of five sessions with percent imitation within the discrimination criterion or, till S+ probe trial percent imitation decreased to a level where continuation would be likely to result in a complete loss of imitation on S+ probe trials.

5.2.33 Phase 3. Sessions 17-30

The training trials reinforcement contingencies were again reversed. All conditions were the same as those for Phase 1. Again it was planned to continue till a stable reversal of probe trial performance within the discrimination criterion was achieved or till loss of S+ probe trial imitation seemed likely to occur with further sessions.

5.3 RESULTS

Figure 11 shows percent imitation on S+ and S- training and probe trials for all sessions.

5.3.1 Training Trials

5.3.11 Phase 1. Sessions 1-5

The mean percent imitation was 90 percent (range 80-100 percent) and 18 percent (range 10-30 percent) on S+ and S- training trials respectively. The discrimination criterion was met over the last four sessions.

5.3.12 Phase 2. Sessions 6-16

When the training trials reinforcement contingencies were reversed, behavioural reversal followed. Imitation occurred on 80 percent of the new S+ (no buzzer) training trials in the first reversal session. This was probably related to the non-zero percent imitation on no buzzer (S-) training trials in the previous phase and the adventitious occurrence of a reinforceable S+ training trial imitation early in the first reversal session. However percent imitation on the new S- (buzzer) training trials did not decrease to 20 percent till the fifth reversal session and was less stable following that session.

The crossover of percent imitation for S+ and S- training trials occurred in the third reversal session (see Figure 11) and except in the following session where there was no separation, a directionally appropriate separation was obtained over the remaining eight sessions of this phase. The mean percent imitation for sessions following and including the fifth reversal session where the discrimination criterion was first achieved was 96 percent (range 80-100 percent) and 23 percent (range 0-50 percent) for S+ and S- training trials respectively. The mean separation of percent imitation over the third (crossover) and following reversal sessions in this phase was 59 percent.

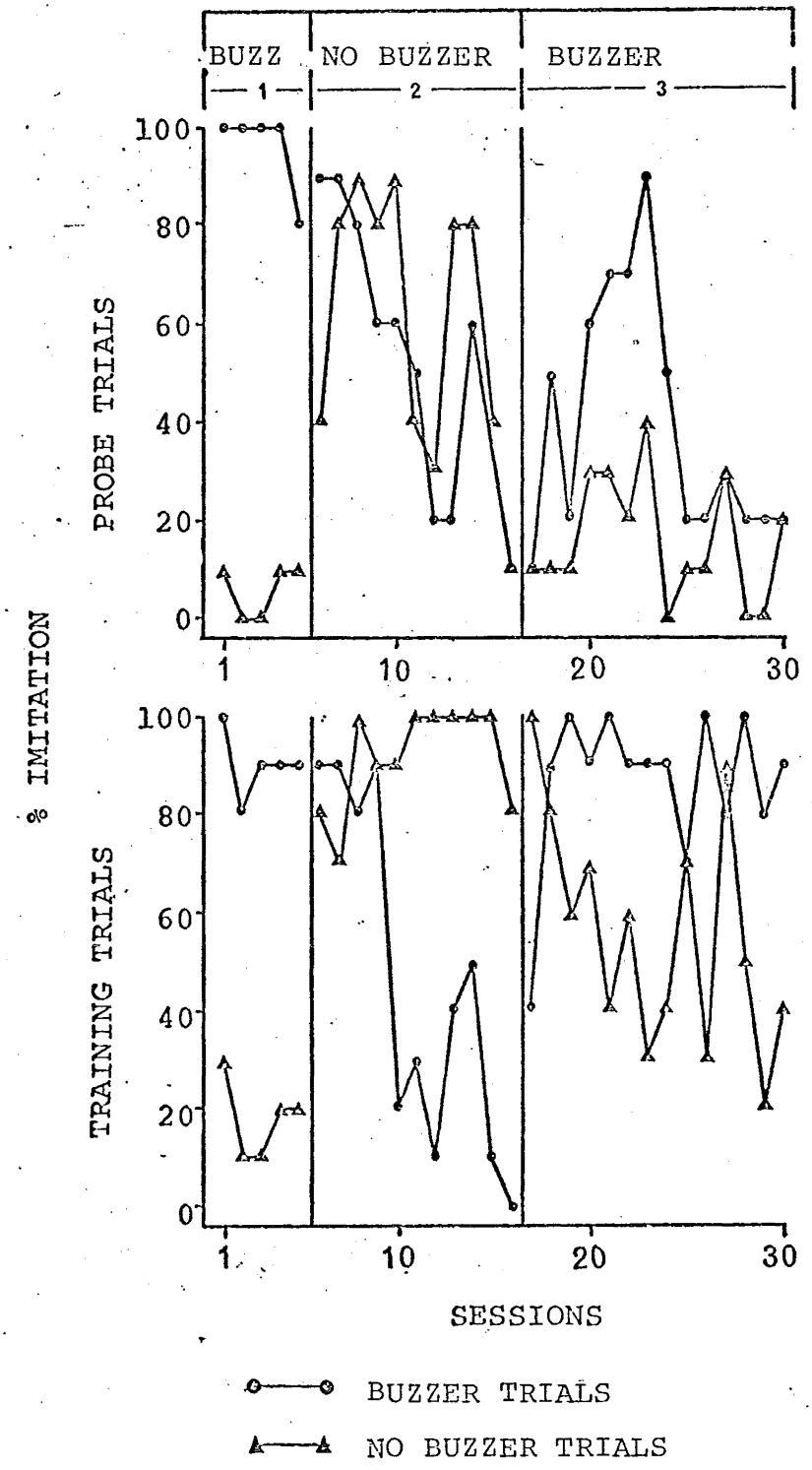

FIGURE 11 Percent imitation on S+ training trials (imitations reinforced), S- training trials, S+ and S- probe trials (imitations not reinforced) for Subject 1 in Experiment 3. Changes in the antecedent stimulus (S+) for reinforced training trial imitations are shown at the top of the figure.

5.3.13 Phase 3. Sessions 17-30

When the reinforcement contingencies for training trial imitations were reversed again, the discrimination performance on training trials was also reversed. Percent imitation on S+ training trials was greater than the 80 percent criterion in the second reversal session. Though crossover of percent imitation on S+ and S- training trials occurred in the second reversal session, percent imitation on S- training trials did not decrease to the 20 percent criterion till the thirteenth reversal session. The mean separation of percent imitation on S+ and S- training trials over the second (crossover) and following reversal sessions in this phase was 38 percent.

5.3.2 Probe Trials

5.3.21 Phase 1. Sessions 1-5

The mean percent imitation was 96 percent (range 80-100 percent) and 4 percent (range 0-10 percent) on S+ and S- probe trials respectively. The discrimination criterion was met over all sessions.

5.3.22 Phase 2. Sessions 6-16

When the training trials reinforcement contingencies were reversed, behavioural reversal occurred on probe trials. Though the changes in percent imitation occurring over the first half of this phase paralleled those occuring on training trials, overall the separation and stability of percent imitation on S+ and S- probe trials was less than that obtained on training trials. Imitation occurred on 80 percent of the new S+ (no buzzer) probe trials in the second reversal session. Imitation on the new S- (buzzer)

probe trials did not decrease to 20 percent till the seventh reversal session.

The crossover of percent imitation for S+ and S- probe trials occurred in the same session as for training trials (i.e. third reversal session) and a small but directionally appropriate separation was maintained over five of the remaining eight sessions but the discrimination criterion was not met in any session. The mean percent imitation for sessions including and following the fifth reversal session where the discrimination criterion was first achieved on training trials was 53 percent (range 10-90 percent) and 37 percent (range 10-60 percent) for S+ and S- probe trials respectively. The mean separation of percent imitation on S+ and S- probe trials over the third (crossover) and following sessions in this phase was 20 percent compared to the 59 percent obtained on training trials.

5.3.23 Phase 3. Sessions 17-30

The second reversal of the reinforcement contingencies for training trial imitations was also followed by a congruent reversal of the direction of separation of percent imitation on "buzzer" (now S+) and "no buzzer" probe trials. Percent imitation on the new S+ probe trials increased to a level above 80 percent by the seventh reversal session but then rapidly decreased to 20 percent over the later sessions. Percent imitation on S- probe trials varied between zero and 40 percent. The discrimination criterion was not met in any session. No crossover of percent imitation curves for S+ and S- probe trials occurred as the percentages for S+ and S- probe trial imitation were identical in the last two sessions of Phase 2 and in the first session of this phase. The mean separation of percent imitation on S+ and

S- probe trials over the second (crossover session for training trials) and following reversal sessions in this phase was 25 percent compared to the 38 percent obtained on training trials.

5.4 DISCUSSION

The results from Phase 1 demonstrate experimental stimulus control of imitation of new response demonstrations. All of the 20 new response demonstrations introduced in Session 1 were imitated on their first S+ trial while only four demonstrations of the same responses were imitated on their first S- trial. These results replicate those obtained during introduction of new responses in Experiments 1 and 2.

The results for training trials over Phases 1, 2 and 3 demonstrate a functional relationship between the stimulus control of training trial imitations and the differential intermittent reinforcement of S+ training trial imitations. The differential reinforcement contingency was reversed in Phase 2 and reversed again in Phase 3 and on both occassions was accompanied by directionally appropriate behavioural reversal on training trials. These results replicate those obtained on training trials during two reversals in Experiment 2, two reversals conducted during the informal investigation briefly described in the introduction of this chapter and are essentially the same as those reported by Williams (1971).

Percent imitation on S+ probe trials was unstable and after an initial increase, decreased to near zero values following each contingency reversal so that the results were similar to those of Experiment 2. However the initial

increases in S+ probe trial imitation in Phases 2 and 3 clearly paralleled increases occurring on S+ training trials over the same sessions and were maintained over a greater number of sessions than during reversals in Experiment 2. Overall the probe trial results for Phases 1, 2 and 3 demonstrate an unstable, but nevertheless functional, relationship between stimulus control of probe trial imitations and the differential reinforcement of S+ training trial imitations.

CHAPTER VI

EXPERIMENT 4: REPLICATION OF EXPERIMENT 3 WITH A NEW SUBJECT

6.1 INTRODUCTION

The previous experiments provided evidence supporting a conceptualisation of one trial acquisition of novel imitations and to some extent of the maintenance of unreinforced imitations on interspersed probe trials (generalised imitation) in terms of abstract or instructional stimulus control. However the generality of this conceptualisation was limited by the fact that it was possible to establish the prerequisite behavioural repertoire for the investigation with only one of the original five developmentally retarded subjects.

In addition, though unstable data precluded any functional analysis of this aspect, the experiments provided cumulative evidence in support of the view that minimising differences in conditions for training and probe trials enhanced the likelyhood of being able to demonstrate a functional relationship between the three term contingencies applied on training trials and the experimentally established stimulus control of unreinforced probe trial imitations. This experiment was conducted using a new subject to extend the generality of these findings..

In Experiment 1 many sessions were required to establish the "go-nogo" discrimination on S+ and S- training

trials which was a prerequisite repertoire for investigation of stimulus control of probe trial imitation. Therefore, a much younger normal child of a similar mental age to Subject 1 was selected for this experiment with the expectation that this would reduce the number of experimental sessions required for the investigation.

Also in this experiment, the experimental conditions imposed initially were those which the previous experimental results had suggested would increase the likelihood of obtaining results demonstrating a clear functional relationship between the training trial contingencies and the to-be experimentally established stimulus control of training trial and of unreinforced probe trial imitations. Later in the experiment the durability of the stimulus control of unreinforced imitations was to be investigated by a return to experimental conditions similar to those used with Subject 1 in Experiment 2 and also more akin to those obtaining in other research reported in this area (e.g. Baer et al., 1967; Peterson, 1968b, Williams, 1971).

A new feature in this experiment, prompted by the experience of attempting to establish and maintain the "go-nogo" discrimination in Experiment 1, involved the substitution of two differently coloured lights for the buzzer presentation and non-presentation as signals to be correlated with reinforcement and extinction procedures used on S+ and S- training trials. Both S+ and S- trials now involved the presentation of a stimulus rather than the absence of a stimulus. The expectation that this change would improve stimulus control was somewhat speculative however, since the

previous experiments involved too many confounded independent variables to allow any data analysis relating to this question.

One further new procedure was adopted in modified form from research reported by Steinman (1970a, 1970b). This involved instructing the subject not to perform unreinforced imitations. It was designed to investigate Steinman's arguement that children will continue to emit unreinforced imitations on interspersed probe trials under the control of social setting or instructional stimuli even though they are able, given different experimental conditions, to imitate on S+ training trials (reinforced) while not imitating on S+ probe trials (unreinforced). If S+ probe trial imitations occurred frequently prior to this manipulation but occurred much less often during the "do not perform unreinforced imitations" instruction condition, Steinman's position and that of Martin, J., (1971b, 1972) would be supported. In addition this would provide evidence that Bandura's view (Bandura, 1969a, 1969b, 1971; Bandura and Barab , 1971) that children continue to perform unreinforced imitations because they cannot "discriminate" between the stimulus topographies of response demonstrations following which imitations will be reinforced and not reinforced, is unlikelely to be correct. Such results could also be interpreted to support Martin's (Martin, J., (1971b, 1972) view that so called generalised imitation is simply a special case of generalised instruction following behaviour.

6.2 METHOD

6.2.1 Subject

The subject used in this experiment, Subject 6, was a developmentally normal boy aged 5 years 2 months at the beginning of the experiment. His Stanford-Binet (L-M) IQ was 107, he met the five criteria for subject selection used in Experiment 1, and he had just begun attending primary school. He was the son of a professional couple who allowed one room of their home to be used as an experimental room.

6.2.2 Setting

The subject was seen by himself for 15 to 30 minute experimental sessions conducted once per day, seven days of the week. Sessions were conducted in a spare bedroom in his home approximately 3.6 x 2.8 m in dimension, containing a bed, three chairs, a dressing table, another small table and a built in wardrobe.

During experimental sessions the signal lights and the reinforcer tray to be described in the following section were placed on the table beside the experimenter and on the dressing table respectively. At the beginning of each trial the subject was usually seated on a chair and the experimenter stood facing the subject from a distance of about 1.5 m.

6.2.3 Apparatus and Materials

The signals variously used as S+ and S- were a blue light bulb (Philips 60W) and a yellow light bulb (Osram 60W) set 25cm apart on top of a 35 x 18 x 16 cm cardboard box. The lights were independently and remotely operable from a distance of about 4 m using two press button type switches

mounted on a hand sized holder. The lights operated off the household power supply.

A variety of small commercially available confections and one cent pieces were used as reinforcers following Bijou and Sturges (1959) recommendation that a variety of items should be used where experiments are expected to involve a relatively large number of sessions. The actual items used were based on the subjects most frequent choices over previous sessions and on the subjects and his parents suggestions for new reinforcers. The reinforcers were displayed in a 22 x 30 cm, 12 cup patty pan.

A stop watch, data recording sheets and a variety of objects required for the demonstration and imitation of various responses were also used.

6.2.4 General Procedure

Imitations were defined in the same way as for Experiment 1 and sessions were conducted in the same trial by trial fashion with trial performances being scored and recorded on pre-prepared data sheets as in the previous experiemnts. The data sheets were kept behind the signal light system where they could not be seen by the subject.

6.2.5 Reliability

An observer, equipped with a stop watch and pre-prepared data sheet, conducted reliability checks during Sessions 25 and 38. Percent agreement was calculated as for Experiment 1.

6.2.6 Experimental Conditions

6.2.61 Phase 1. Sessions 1-4

Each session consisted of 40 trials for imitation not counting correction trials). In Sessions 1, 2, 3 and 4

responses numbered 1, 1 and 2, 1 to 5 and 1 to 10 were demonstrated (see Tables 16 and 17). The responses to be demonstrated were quasi-randomly assigned to trials anew for each session with the restraints that;

(1) there must be an equal number of trials for each response;

(2) there must be an equal number of S+ and S- trials for each response;

(3) there must be no more than two consecutive trials for the same response;

(4) there must be no more than two consecutive S+ and S- trials.

The S+ and S- consisted of a two second presentation of the yellow and blue lights respectively, immediately following response demonstrations. Imitations on S+ training trials were reinforced on a continuous schedule (CRF) and S- training trial imitations were not reinforced. Over Sessions 1-3 a correction procedure was used so that every S+ training trial (or sequence of S+ training correction trials) terminated with the emission of a reinforced imitation, and every S- training trial (or sequence of S- training correction trials) terminated with a 10 second period following trial presentation during which no imitation was emitted. A non-correction procedure was used in the fourth session.

At the beginning of Session 1 the experimenter operated the yellow light and asked "What colour is that light?", waited for the correct answer and replied "Yes, that's right (child's name)" and repeated the procedure with the blue light. The experimenter then said "We're going to play a game (child's name). First look at me and then look at the lights." The second sentence of the instruction was repeated once. No direct instructions about imitating the

experimenters response demonstrations were given. The session proper was then begun. Physical guidance and other non-verbal prompts were used on correction trials where necessary to establish S+ training trial imitations of new response demonstrations. Imitations emitted on S+ training trials were immediately reinforced. The experimenter first praised the child using statements such as "That was a good one (child's name)" and then said "Now you can choose one thing from the tray." The subject was allowed to consume sweets immediately or save them till the end of the session. Trials were always delayed till the sweet had been completely consumed.

6.2.62 Phase 2. Sessions 5-13

The yellow and blue lights were used for the S+ and S- respectively as in Phase 1. The non-correction procedure begun in Session 4, and the quasi-random method of assignment of response demonstrations to trials and the associated restraints, were both continued. Each session consisted of 40 trials.

Twenty new responses, numbered 11 to 30, were introduced over Sessions 5-8 and responses numbered 1 to 10 were dropped out of sessions in numerical order to keep the total number of different responses demonstrated in each session constant at 20. Sessions 8 and thereafter included two demonstrations of each of responses numbered 11-30 (see Tables 16 and 17). Fifteen of the new responses were training responses and five were probe responses. Odd numbered responses were first demonstrated on S+ trials and even numbered responses were first demonstrated on S- trials. The second demonstration of each response occurred on an S-

TABLE 16

Responses demonstrated to Subject 6 in Experiment 4. The symbols + and - show whether the response was first demonstrated in the context of an S+ or an S- trial respectively. Asterisks indicate probe responses.

Response Number	Response Description	First Demonstration	Session Introduced
1	Raise left arm	+	1
2	Tap table	-	2
3	Tap chest	+	3
4	Tap wall	-	3
5	Hands on head	+	3
6	Put on hat	-	4
7	Hands on knees	+	4
8	Build 3 block tower	-	4
9	Touch nose	+	4
10	Put hat on chair	-	4
11	Arms horizontally forward	+	5
12	Sit on another chair	-	5
13	Hands on eyes	+	5
14	Put beads around neck	-	5
15	Arms horizontally sideways	+	5
16	Open match box	-	5
*17	Hands on ears	+	5
*18	Put block in box	-	5
19	Walk on spot	+	5
20	Walk round chair	-	5
21	Hands on hips	+	5
22	Put box on dressing table	-	6
*23	Clasp hands	+	6
24	Open "Padawax" container	-	6
25	Nod "yes"	+	7
*26	Tap chair	-	7
27	Touch toes	+	7
28	Put box over block	-	7
*29	Hands above head	+	8
30	Put hat on dressing table	-	8

TABLE 17

The sequence of experimental conditions in Experiment 4.

Phase	Session number	Experimental Stimuli: Light Colour S+	S-	Reinforcement Schedule for S+ Training Trial Imitations	No. of Items given per Reinforcement Occassion	Response Numbers Included in Sessions	Other Procedures Used
1	1	Yellow	Blue	CRF	1	1	correction
	2	Yellow	Blue	CRF	1	1-2	correction
	3	Yellow	Blue	CRF	1	1-5	correction
	4	Yellow	Blue	CRF	1	1-10	non-correction
2	5	Yellow	Blue	VR1.1*	1 or 2	1-20	non-correction
	6	Yellow	Blue	VR1.3	1 or 2	5-24	non-correction
	7	Yellow	Blue	VR1.6	1 or 2	9-28	non-correction
	8	Yellow	Blue	VR2.1	2 or 3	11-30	non-correction
	9-13	Yellow	Blue	VR3	3	11-30	non-correction
3	14-15	Blue	Yellow	CRF	1	11-30	3 prompts
	16-25	Blue	Yellow	VR3	3	11-30	non-correction
4	26	Yellow	Blue	VR1.3	2	11-30	non-correction
	27-33	Yellow	Blue	VR3	3	11-30	non-correction
5	34-38	Yellow	Blue	CRF	1	11-30	non-correction
6	40-41	Blue	Yellow	CRF	1	11-30	non-correction
	42	Blue	Yellow	CRF	1	11-30	1 prompt
	43-44	Blue	Yellow	CRF	1	11-30	non-correction
Test for discrimination between training and probe response demonstrations.							
Test for reversal of stimulus control of imitations of responses numbered 1-10							

* Numerals specifying ratio size are derived from the actual number of S+ training trials on which an imitation was emitted divided by the number of reinforcement occassions. However, VR3 specifies a maximum ratio size for sessions where imitation occurred on every S+ training trial. In practise the ratio was often slightly less than three.

trial if the first occurred on an S+ trial and vice versa. Including responses introduced over Phases 1 and 2, the result was that 12 of 25 training responses, and three of the five probe responses were first demonstrated on S+ trials.

Imitations emitted on S+ training trials were reinforced on a variable ratio schedule (VR). The ratio was gradually increased to a maximum value of three (i.e. VR3) in Session 9 and the following sessions. Concurrently, the number of items given to the subject on each reinforcement occassion was increased in stages from one up to three to keep the number of reinforcer items delivered each session roughly constant (see Table 17). When S+ training trial imitations were to be reinforced the experimenter now said "Thats right (child's name). This time you can choose two (or three) things from the tray". When S+ training trial imitations were emitted but not scheduled for reinforcement on that trial, the experimenter said nothing and waited 10 seconds before recording the result and proceeding to the next trial. If the subject approached the reinforcer tray on these occassions the experimenter said "No, you only get things when I tell you." which always resulted in the subject returning to his chair. This intervention was required only occassionally. All changes in conditions had been implemented by Session 9.

6.2.63 Phase 3. Sessions 14-25

The training trials reinforcement contingencies were reversed so that now the S+ and S- were the blue and yellow lights respectively. Over Sessions 14 and 15 S+ training trial imitations were reinforced on a CRF schedule

and S+ training trial imitations were prompted on three occassions to accelerate the behavioural reversal.

The prompts were used on correction trials and the resultant imitations were reinforced but not included in the calculation of percent imitation for the session. Two prompted correction trials were conducted in Session 14 as follows:

(1) the experimenter asked the subject to stand and watch him carefully;

(2) following the response demonstration the experimenter stared intently at the subject and murmurred "mm";

(3) the blue light (previously S- but now S+) was not presented till the subject had begun the imitation;

(4) the imitation was reinforced.

A partially faded prompt consisting of the experimenter following the response demonstration by smiling and nodding at the subject but with the new S+ also presented at the same time was used on a single S+ training (correction) trial in Session 15. The non-correction procedure was still applied for all other trials.

Over Sessions 16-25 all conditions, with the exception of the reversed training trials reinforcement contingencies, were the same as those for Sessions 9-13 in Phase 2 (see Table 17).

6.2.64 Phase 4. Sessions 26-33

The reinforcement contingencies for training trials were again reversed so as to reinstate the conditions for Sessions 9-13 in Phase 2. No prompts or correction trials were required to effect the behavioural reversal, but in Session 26 S+ training trial imitations were reinforced on a

VR1.3 schedule. The VR3 schedule was reinstated for Sessions 27-33.

6.2.65 Phase 5. Sessions 34-38

Imitations emitted on S+ training trials were now reinforced on a CRF schedule. The number of reinforcer items given on each reinforcement occassion was reduced from three to one to keep the number delivered each session roughly constant. To reinforce imitations the experimenter now said "That's right (child's name), now you can choose one thing from the tray". All other conditions remained the same as before.

6.2.66 Phase 6. Sessions 39-44

The reinforcement contingencies for training trials were again reversed so that the S+ and S- were now the blue and yellow lights respectively. A prompt was used to occassion a reinforceable imitation on the first S+ training trial in Session 42. The prompt involved rapidly flicking the blue light on and off several times following the response demonstration instead of the usual two second presentation. The imitation was reinforced but not included in the calculation of percent imitation. All other conditions were the same as for Sessions 34-38 in Phase 5.

6.2.67 Test for Discrimination between Training and Probe Response Demonstrations

Following completion of Session 44 a test of the subjects ability to discriminate between S+ training trials where imitations had been reinforced on a CRF schedule during Phase 6 and S+ probe trials on which imitations had not been reinforced, was conducted.

Just before the test the subject was instructed twice

that "From now on I only want you to copy me when you know you'll get a lolly for it. Remember, don't do the ones where you don't get lollies". A randomly determined sequence of responses (viz. responses numbered 13, 19, 26, 21, 25, 18, 12, 17, 24, 15, 23, 24, 27) was then demonstrated in the context of S+ trials. Trials were conducted in the same way as before. Imitations emitted on S+ training trials were reinforced while those emitted on S+ probe trials were not reinforced. No feedback was given on trials where no imitation occurred.

6.2.68 Test for Reversal of Stimulus Control of Imitations of Responses Numbered 1-10

Immediately following the discrimination test, responses numbered 1 to 10 were demonstrated to the subject to test the generality of the reversal of stimulus control of imitations. These responses had not been used beyond Session 7 and had only been demonstrated during sessions where the S+ and S- were the yellow and blue lights respectively. They were now re-presented to the subject on both S+ (now blue light) and S- (now yellow light) trials under Phase 6 experimental conditions. The responses were demonstrated in numerical order with odd and even numbered responses demonstrated on S+ and S- trials respectively. The sequence was repeated with odd and even numbered responses demonstrated on S- and S+ trials respectively so that each of the 10 responses was demonstrated once on an S+ trial and once on an S- trial. Imitations emitted on S+ trials were reinforced while those emitted on S- trials were not reinforced. A non-correction procedure was used.

6.3 RESULTS

6.3.1 Reliability

The agreement between the experimenter and the observer was 100 percent for both reliability check sessions.

6.3.2 Acquisition of New Imitations

Figure 12 shows that a decreasing number of S+ trials (including S+ correction trials during Phase 1) was required to establish imitations of successive new response demonstrations to a criterion of one unprompted S+ trial imitation. Physical guidance, prompting and fading was required to establish imitation of the first three responses. The fourth and subsequent new responses, with the exception of number 25, were imitated on their first S+ trial demonstration.

6.3.3 Development of Stimulus Control

Figure 13 shows that imitation and non-imitation of new response demonstrations rapidly came under the control of the yellow (S+) and blue (S-) lights respectively. Responses numbered 1, 2 and 3 were not imitated on their first S+ trial demonstrations, but all the remaining responses except number 25 were imitated on their first S+ trial demonstration. Response number 1, which had first been demonstrated in the context of a number of prompted S+ training (correction) trials, was imitated on its first S- trial demonstration. None of the remaining 29 responses were imitated on their first S- trial demonstration.

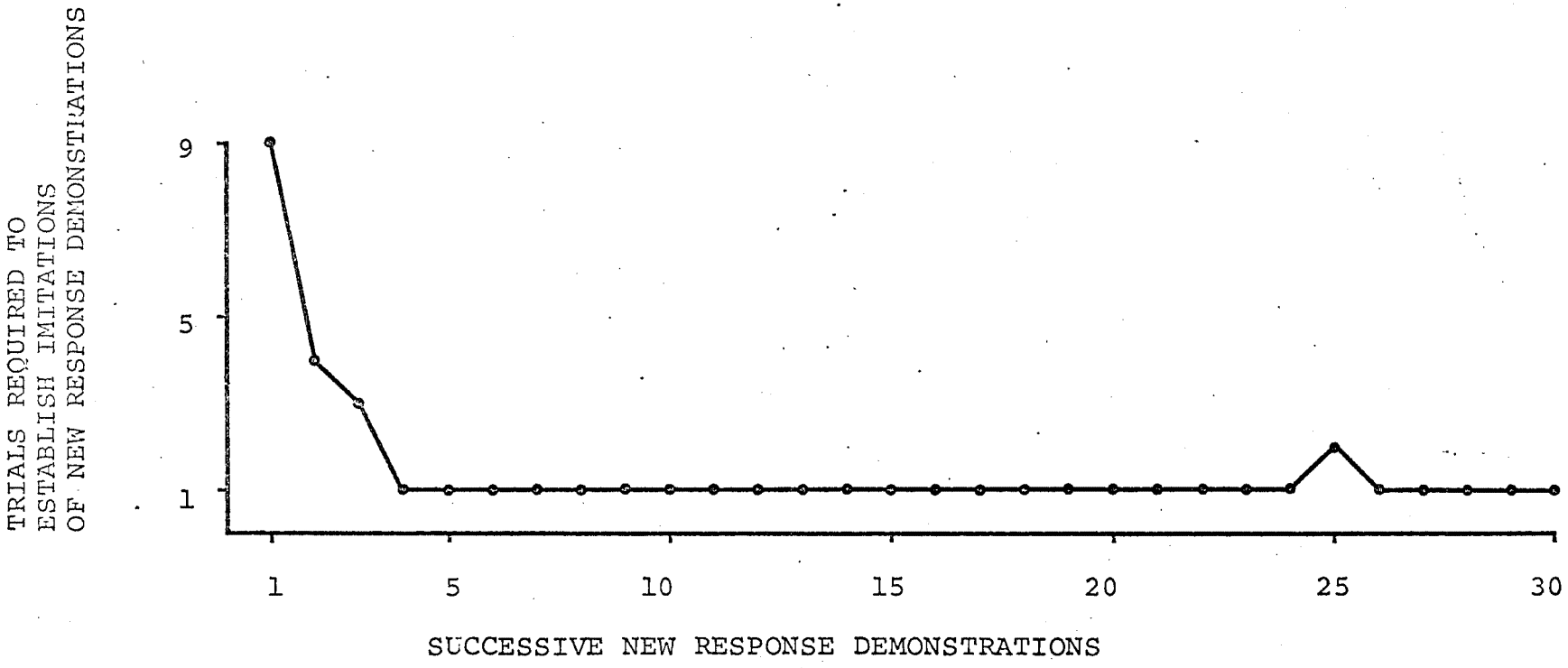

FIGURE 12 Number of trials required to establish S+ trial imitations of successive new response demonstrations to a criterion of one unprompted imitation for Subject 6 in Experiment 4.

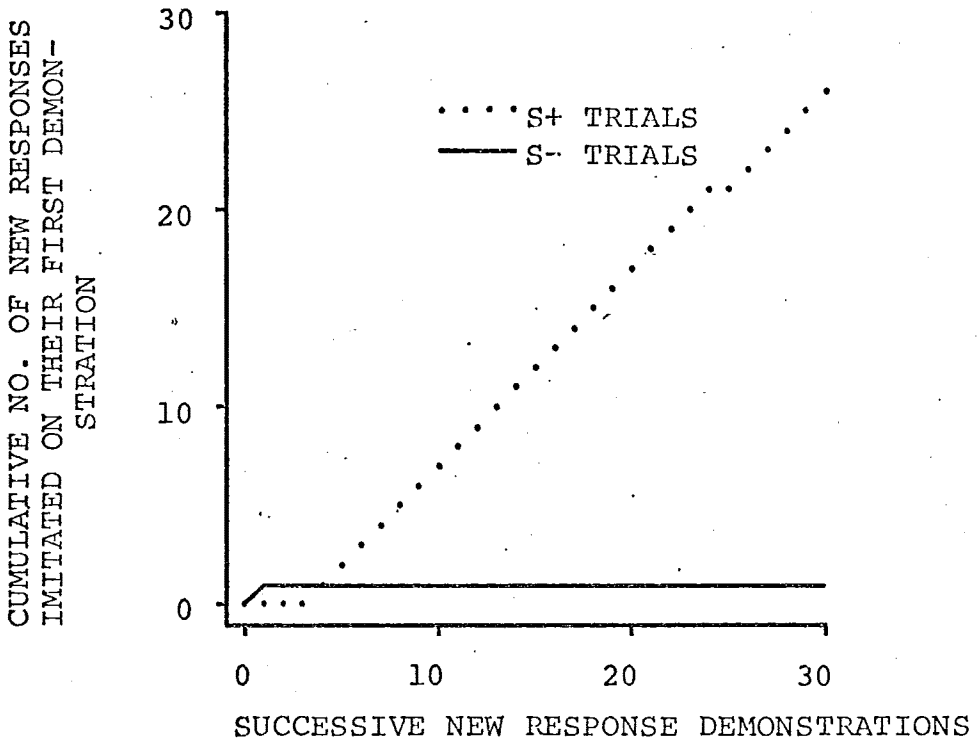

FIGURE 13 Cumulative number of successive new response demonstrations imitated on their first S+ and S- trial presentation for Subject 6 in Experiment 4.

6.3.4 Training Trials

6.3.41 Phase 1. Sessions 1-4

The discrimination criterion (percent imitation equal to or greater than 80 percent on S+ trials and less than or equal to 20 percent on S- trials) was met in all sessions. The mean percent imitation was 96 percent (range 95-100 percent) and 4 percent (range 0-10 percent) on S+ and S- training trials respectively. The change to the non-correction procedure in Session 4 did not disrupt the discrimination performance.

6.3.42 Phase 2. Sessions 5-13

The introduction of probe trials and the shift from a CRF to a VR3 schedule of reinforcement did not disrupt the discrimination performance on training trials. The discrimination criterion was met in all sessions. The mean percent imitation was 93 percent (range 80-100 percent) and 2 percent (range 0-7 percent) on S+ and S- training trials respectively. The decrease to 80 percent imitation on S+ training trials in Session 8 was correlated with the subjects report of stomach pain and with noticeably sluggish movement. The following day physical illness was diagnosed and treated by the family's doctor. Session 9 was conducted four days after Session 8.

6.3.43 Phase 3. Sessions 14-25

When the reinforcement contingencies for training trials were reversed, behavioural reversal occurred on training trials (see Figure 14). The discrimination criterion was met in the seventh and following five sessions of this phase. Percent imitation on the new S+ (blue) training trials increased more rapidly than percent imitation on the new S-

training trials decreased. The mean percent imitation for the six sessions including and following Session 20 where the discrimination criterion was first met was 96 percent (range 80-100 percent) and 6 percent (range 0-13 percent) on S+ and S- training trials respectively.

6.3.44 Phase 4. Sessions 26-33

When the training trials reinforcement contingencies were again reversed, behavioural reversal was again obtained on training trials (see Figure 14). The discrimination criterion was first met in the sixth session of this phase. Again, percent imitation on the new S+ (yellow) training trials increased more quickly than percent imitation on the new S- training trials decreased. The mean percent imitation for the three sessions including and following Session 32 where the discrimination criterion was first met was 96 percent (range 87-100 percent) and 18 percent (range 0-20 percent) for S+ and S- training trials respectively.

6.3.45 Phase 5. Sessions 34-38

The change from VR3 to a CRF schedule for S+ training trial imitations was accompanied by a small increase in the separation of percent imitation on S+ and S- training trials. The mean percent imitation over the five sessions was 97 percent (range 93-100 percent) and 7 percent (range 0-13 percent) for S+ and S- training trials respectively.

6.3.46 Phase 6. Sessions 39-44

When the training trials reinforcement contingencies were reversed for the third time; the behavioural reversal did not occur till an S+ training trial imitation was prompted and reinforced early in Session 42. The reversal then occurred rapidly and the discrimination criterion was met in

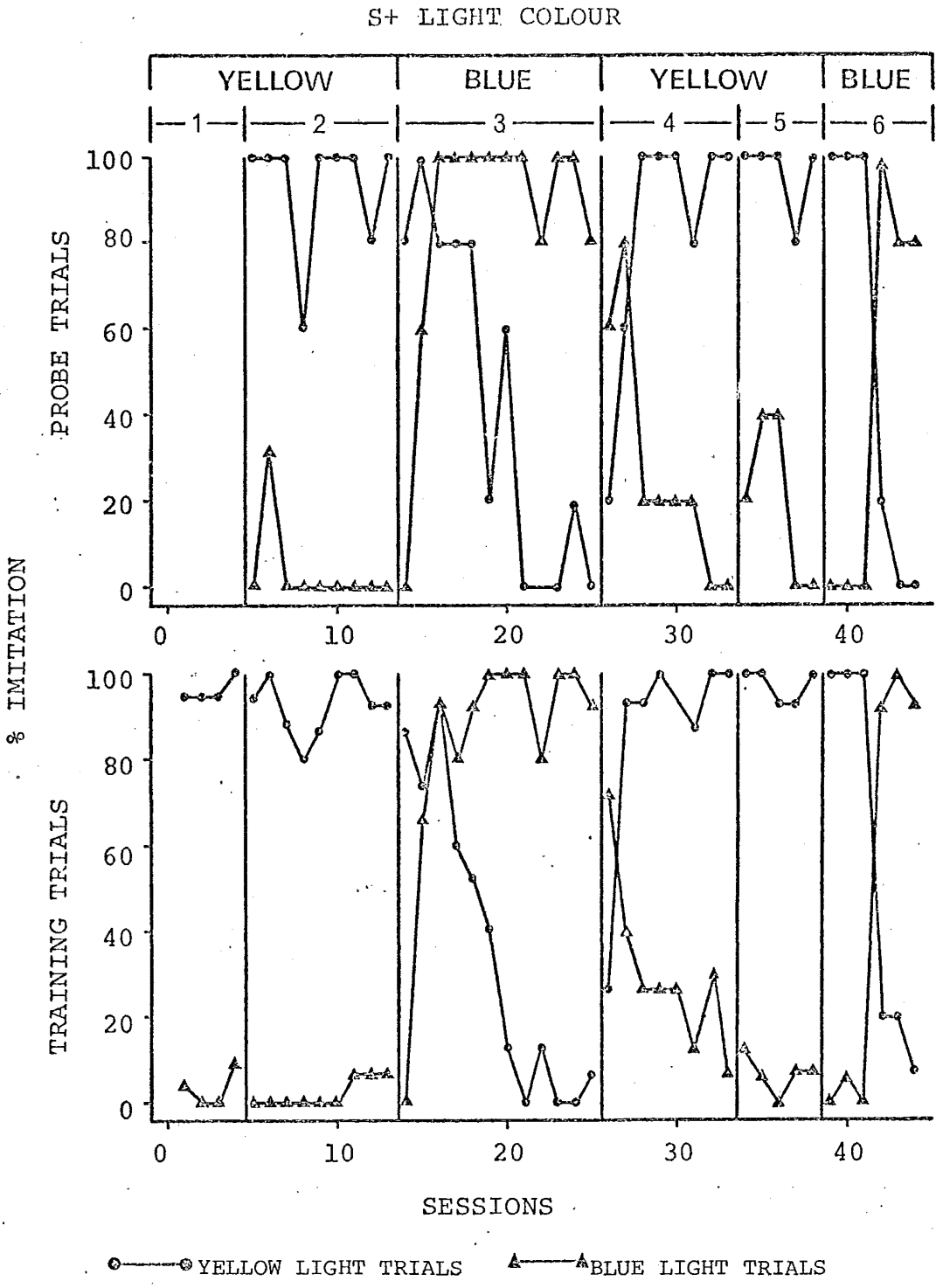

FIGURE 14 Percent imitation on S+ training trials (imitations reinforced), S- training trials, S+ and S- probe trials (imitations not reinforced) for Subject 6 in Experiment 4. Changes in the antecedent stimulus (S+) for reinforced training trial imitations are shown at the top of the figure. Other changes in experimental conditions are shown in Table 17.

the same session. On this reversal, per cent imitation on S- training trials decreased almost as rapidly as per cent imitation on S+ training trials increased. The mean per cent imitation over the three sessions including and following Session 42 where the discrimination criterion was first met was 95 per cent (range 93-100 per cent) and 16 per cent (range 7-20 per cent) for S+ and S- training trials respectively.

6.3.5 Probe Trials

6.3.51 Phase 2. Sessions 5-23

The mean per cent imitation over all sessions in this phase was 93 per cent (range 60-100 per cent) and 4 per cent (range 0-33 per cent) for S+ and S- probe trials respectively. The decrease to 60 per cent imitation on S+ probe trials in Session 8 appeared to be related to the subjects illness as did a similar atypically low per cent imitation on S+ training trials in the same session (see Figure 14).

6.3.52 Phase 3. Sessions 14-25

When the reinforcement contingencies for training trials were reversed, behavioural reversal occurred on probe trials. The probe trial reversal results were similar to those for training trials. Per cent imitation on S+ probe trials increased more rapidly than per cent imitation decreased on S- probe trials and the crossover of per cent imitation for S+ and S- probe trials occurred in Session 16 as it did for S+ and S- training trials. The discrimination criterion was first met in the sixth session of this phase. The mean per cent imitation over the six sessions including and following Session 20 where the discrimination criterion was first met on

training trials was 93 per cent (range 80-100 per cent) and 13 per cent (range 0-60 per cent) for S+ and S- probe trials respectively.

6.3.53 Phase 4. Sessions 26-33

When the training trials reinforcement contingencies were again reversed, behavioural reversal was again obtained on probe trials (see Figure 14). The probe trial reversal results were again similar to those for training trials, though the discrimination criterion was first met sooner than for training trials (Session 31) in Session 28. The crossover of per cent imitation for S+ and S- probe trials occurred in Session 28, one session later than for S+ and S- training trials. The mean per cent imitation over the three sessions including and following Session 31 where the discrimination criterion was first met on training trials was 93 per cent (range 80-100 per cent) and 7 per cent (range 0-20 per cent) for S+ and S- probe trials respectively.

6.3.54 Phase 5. Sessions 34-38

The change from a VR3 schedule to a CRF schedule for S+ training trial imitations was accompanied by a temporary increase in per cent imitation on S- probe trials. However the overall probe trials performance did not differ greatly from that obtained on probe trials over the last three sessions of Phase 4 or from that obtained on training trials in Phase 5. The mean per cent imitation was 96 per cent (range 80-100 per cent) and 20 per cent (range 0-40 per cent) for S+ and S- probe trials respectively.

6.3.55 Phase 6. Sessions 39-44

When the training trials reinforcement contingencies were reversed for the third time the probe trial reversal results were again similar to those for training trials.

When an S+ training trial imitation was prompted and reinforced early in Session 42, behavioural reversal rapidly followed and the discrimination criterion was met in the same session in the same way as on training trials. The mean percent imitation over the three sessions including and following Session 42 was 87 percent (range 80-100 percent) and 7 percent (range 0-20 percent) for S+ and S- probe trials respectively.

6.3.6 Test for Discrimination between Training and Probe Response Demonstrations

When the subject was instructed not to perform unreinforced imitations, an imitation was emitted on seven of eight S+ training trials where imitations were reinforced but only on one of five S+ probe trials where imitations were not reinforced. The single unreinforced S+ probe trial imitation occurred on the last of five S+ probe trials included in the sequence of response demonstrations. Table 18 shows a comparison of these results with those obtained from demonstrations of the same 13 responses during Session 44 immediately before the test.

6.3.7 Test for Reversal of Stimulus Control of Imitations of Responses Numbered 1-10

Table 19 shows the reversal of frequency of imitation of demonstrations of responses numbered 1 to 10 for yellow and blue light trials when these responses were re-presented to the subject after not being included in the previous 38 sessions. Some of these responses had last been demonstrated in Session 7 but Session 5 was the last session including all

TABLE 18

Frequency of imitation on S+ training and probe trials immediately before and after the subject was instructed not to perform unreinforced imitations for Subject 6 in Experiment 4.

Type of Trial	N*	Imitation Frequency	
		Before Instruction	After Instruction
S+ Training Trials (reinforced)	8	8	7
S+ Probe Trials (un reinforced)	5	4	1

N*: Number of opportunities to imitate (trials).

TABLE 19

Frequency of imitation of demonstrations of responses numbered 1-10 on yellow and blue light trials during Session 5 and following Session 44 for Subject 6 in Experiment 4.

Session	Training Trials Reinforcement Contingencies	Imitation Frequency	
		Yellow Light Trials	Blue Light Trials
5	Yellow = S+: Imitations reinforced on VR1.1 Blue = S-: Imitations not reinforced	9 N* = 10	0 N = 10
after 44	Blue = S+: Imitations reinforced on CRF Yellow = S-: Imitations not reinforced	2 N = 10	9 N = 10

*N: Number of opportunities to imitate (trials).

10 responses. The imitation frequency was high for the light colour which had been an antecedent for reinforced imitations in the immediately preceeding sessions and was low for the light colour which had been an antecedent for unreinforced imitations.

6.4 DISCUSSION

The reduction in the number of training trials required to establish new imitations on S+ trials was extremely rapid (see Figure 12). Though the subjects imitative repertoire was not tested before the experiment in order to avoid communicating to the subject what was required, in view of his environment, age and measured IQ it was almost certain he had already acquired such a repertoire. Hence these results are likely to reflect the development of instructional control (by the non-verbal experimental stimulus) of the childs imitative behaviour rather than the development of an imitative repertoire per se.

The inclusion in the experimental design of a discrimination training procedure involving presentation of S- trials for imitations of the same responses as were demonstrated on S+ trials made it possible to investigate the development of stimulus control over new imitations as well as those which had specifically been trained. Figure 13 shows that for responses numbered 4-30 all but one were imitated on the first S+ trial demonstration but none were imitated on their first S- trial demonstration. The experimental design also involved alternation of the order of the first S+ and S- trial demonstrations of successive new

responses so that these results cannot be accounted for in terms of an order effect as might have been the case if the order had always been S- followed by S+ trials. These results show that non-verbal experimental stimuli which had been included in a differential reinforcement contingency and an extinction contingency for imitations of some responses (responses numbered 1-3) may acquire control of emission or non-emission respectively of imitations of demonstrations of other responses (those numbered 4-30).

When responses numbered 11-30 were demonstrated in each session the stimulus control of both probe and training trial imitations was maintained over Sessions 8-13 (see Figure 14). The results of the three reversals demonstrated that this stimulus control of the probe trial imitations as well as of the training trial imitations was functionally related to the relationship between the training trials reinforcement and extinction contingencies and the associated antecedent stimuli. However, the colours and positions of the lights were confounded so that the precise locus of control could not be specified. Never-the-less, the essential relationship between the antecedent stimuli (colour and/or position of lights) and the associated arranged consequences of imitation on training trials and its effect on probe trial imitations was demonstrated. It was considered that further experimental manipulation to more precisely determine the locus of stimulus control would not be relevant to the main issue of this experiment.

The results differed from those of Experiments 2 and 3 in that S+ probe trial imitation was maintained following

each reversal. This experiment differed from the previous ones in that the subject was developmentally normal, two stimuli were used for the S+ and S- instead of the presence versus absence of one stimulus, the stimuli were visual rather than auditory, the correction procedure was discontinued as soon as possible, and the intermittent reinforcement schedule for S+ training trial imitations was introduced at the same time as the first of the probe responses. The potential contribution of most of these changes to the maintenance of S+ probe trial imitation could not be estimated.

Phases 5 and 6, where S+ training trial imitations were reinforced on a CRF schedule, were included in the design to determine whether S+ probe trial imitation would continue to be maintained under these conditions. Imitation continued to occur on S+ probe trials during Phase 5 and following the reversal in Phase 6. These results suggest that maintenance and successful reversal of probe trial performance may not have been dependent on intermittent reinforcement of S+ training trial imitations for this subject. However these results could be attributed to the recent history of intermittent reinforcement. Unfortunately the experiment had to be terminated too early to determine whether S+ probe trial imitation would continue to occur under CRF conditions, or whether as Bandura (Bandura, 1969a, 1969b; Bandura and Barab, 1971) and the results of the previous experiments would predict, that continued differential reinforcement of S+ training trial imitations on a CRF schedule would be accompanied by a decrease in percent imitation on S+ probe trials.

Bandura (Bandura, 1969a, 1969b; Bandura and Barab, 1971) has also argued that continued imitation on interspersed probe trials can be accounted for in terms of the non-discriminability of topographically similar response demonstrations presented on training and probe trials. The results of the "test for discrimination between training and probe response demonstrations" (see Table 18) show that under appropriate instructional conditions the subject was able to tell the difference between response demonstrations following which imitations would or would not be reinforced. Since no imitation occurred on the first four of the five probe trials included in the test sequence, the low frequency of imitation on S+ probe trials cannot be accounted for in terms of contact with the extinction contingency for probe trial imitations during the test. These results are consistent with those of Bufford (1971), Steinman (1970a, 1970b) and Steinman and Boyce (1971) in suggesting that continued emission of imitations on S+ probe trials cannot simply be accounted for in terms of discrimination difficulty.

The results of the "test for reversal of stimulus control of imitations of responses numbered 1-10" (see Table 19) lent support to the view that individual imitative behaviours may be organised as members of an imitative response class by virtue of a common controlling stimulus class. That is, that under appropriate conditions emission of imitative behaviours may be controlled by a class of stimuli in the presence of which other imitative behaviours have been reinforced. The reversal obtained here was significant in that none of the 10 responses had previously been demonstrated during sessions where the S+ and S- were

respectively the blue and yellow lights.

The results of this experiment, carried out using a developmentally normal subject, conditions minimising the differences between training and probe trial procedures and visual instead of auditory stimuli, replicate the essential findings of Experiments 2 and 3. As well, it provides less ambiguous evidence supporting a conceptualisation of maintained unreinforced imitation, as well as of one trial acquisition of new imitations, in terms of abstract (Skinner, 1953) or instructional (Goldiamond, 1966) stimulus control of members of an imitative response class, or as a special case of generalised instruction following behaviour (Martin, J., 1971, 1972).

CHAPTER VII

GENERAL DISCUSSION

7.1 SUMMARY OF RESULTS

7.1.1 S+ Trial Training of New Imitations

Imitation training procedures produced S+ training trial imitation with five developmentally retarded subjects and one normal subject. Three of the retarded subjects acquired very few imitations. This resulted from difficulties in teaching a discrimination between S+ and S- training trials rather than any difficulty in training imitations per se. Accelerated acquisition of successive new imitations occurred with three retarded subjects and the normal subject.

7.2.2 Discrimination Training

Discrimination training procedures established stable stimulus control of imitation with only one retarded subject (Subject 1) and with the normal subject (Subject 6). Emission of imitations was temporarily controlled by the S+ experimental stimulus with two other retarded subjects.

Two of the retarded subjects and the normal subject showed an increased frequency of first S+ trial imitation and a decreased frequency of first S- trial imitation of the same new response demonstrations as successive new responses were included in the discrimination training procedure. For these three subjects the first

trial acquisition of new imitations aspect of generalised imitation was controlled by the S+ experimental stimulus.

7.1.3 Introduction of Probe Trials.

When the stimulus controlled repertoires of Subjects 1 (retarded) and 6 (normal) were probed the initial results conformed with expectations stated in the rationale in Chapter 2 for all sets of probe responses. That is, per cent imitation was greater on S+ than on S- probe trials and per cent imitation on S+ and S- probe trials was similar to that on S+ and S- training trials respectively. With Subject 6, this stimulus control of unreinforced probe trial imitations was maintained over the six sessions preceding the first reversal of training trial contingencies. With Subject 1, similar control was maintained over the five (or more) sessions preceding training trial contingency reversals for two of the three sets of probe responses for which results were formally reported.

Hence the training trial results demonstrating experimental stimulus control of first trial acquisition of new imitations were replicated for unreinforced imitations with all four sets of probe responses. Results directly supporting a stimulus control interpretation of the other aspect of generalised imitation - maintained emission of unreinforced imitations - were obtained prior to contingency reversals with three of the four sets of probe responses.

7.1.4 Reversal of Training Trial Contingencies

Reversal of the differential reinforcement contingency for S+ training trial imitations was followed by behavioural reversal on training trials with both subjects (Subjects 1 and 6). This result was replicated in three further reversals for Subject 1 and in two further reversals for Subject 6. Stimulus control of training trial imitations was dependent on inclusion of the antecedent stimulus in the differential reinforcement contingency.

With Subject 1, three sets of probe responses were included in a total of five reversals. Following one reversal no imitation occurred on S+ probe trials. A partial and temporary behavioural reversal occurred on probe trials during the other four reversals. That is the frequency of imitation was greater on S+ than on S- probe trials but the separation was only about half that between S+ and S- training trials. Complete and stable reversal of probe trial imitation was never obtained with Subject 1. Separation of S+ and S- probe trial imitation frequencies in a direction opposite to the expectations stated in Chapter 2 was also never obtained. Despite the low magnitude and lack of durability of the behavioural reversals on probe trials, the number of replications provided some confidence in the view that stimulus control of unreinforced imitations was dependent (when it occurred) on the inclusion of the controlling antecedent stimulus in the differential and reinforcement contingency for S+ training trial imitations.

With Subject 6, one set of probe responses was included during three reversals of the training trial contingencies. The S+ training trial imitations were differentially reinforced according to an intermittent schedule during and preceding the first two reversals, but on a CRF schedule during and preceding the third. On each occasion the behavioural reversal on probe trials was complete and stable. The frequency of S+ probe trial imitation was high and similar to that for S+ training trials while the frequency of S- probe trial imitation was low and similar to that for S- training trials. For this subject, maintained emission of unreinforced imitations was dependent on probe response demonstrations being accompanied by a stimulus which was included as an antecedent in the differential reinforcement contingency for S+ training trial imitations.

7.1.5 Discrimination Between Training and Probe Responses

Subject 1 acquired a discrimination between demonstrations of training responses and the P1 set of probe responses during the first training trial contingency reversal in Experiment 2. This occurred following 150 sessions of imitation and discrimination (between S+ and S- trials) training, the preceding 15 sessions of which had included all the P1 probe responses. In addition the reversal procedure had maximised the contact between the subjects' behaviour and the different contingencies for imitation and nonimitation on S+ training and probe trials.

This discrimination transferred to other sets of probe responses if they were introduced in the context of conditions which emphasised the differences between S+ training and probe trials. That is, S+ probe trial imitation (generalised imitation) decreased rapidly under these conditions. However, when a new set of probe responses was introduced in Experiment 3 under condition minimising the differences between S+ training and probe trials less transfer occurred. Generalised imitation was maintained prior to reversal and the frequency of S+ probe trial imitation did not immediately decrease to S- probe trial levels following each of the two reversals.

When Subject 6 was instructed not to perform unreinforced imitations, discrimination between the topographies of demonstrations of training and probe responses occurred. This test was conducted during the last session of Experiment 4 and hence provided no direct evidence as to whether the same discrimination could have been shown during preceding sessions where stimulus control of generalised imitation was demonstrated.

7.2 IMPLICATIONS OF RESULTS FOR THEORETICAL ACCOUNTS OF GENERALISED IMITATION.

7.2.1 The Conditioned Reinforcement Account

The view that the conditioned reinforcement theory cannot logically account for first trial acquisition of new imitations was discussed in Chapter 1. In the experiments reported here, first trial acquisition occurred on S+ but not on S- trials. This result cannot be accounted

for by the theory without the additional postulate that the same stimulus (similarity to a model) may function as a conditioned reinforcer on S+ trials while not acquiring that function on S-trials. Though this may occur, independent verification with other types of behaviour would seem to be a minimal requirement to warrant extension of the basic account.

The same difficulty is encountered for a conditioned reinforcement account of the other aspect of generalised imitation, maintained emission of unreinforced imitations. During sessions preceding contingency reversals, unreinforced imitations were maintained on S+ but not on S- probe trials with three of the four sets of probe responses.

Bandura (Bandura and Barab, 1971) has argued that if the conditioned reinforcement account is correct, then "the longer imitative responses are positively reinforced, the more strongly behavioural similarity is endowed with reinforcing properties" (p.245). That is, S+ probe trial imitation should be more likely to be maintained as the number of training sessions increases. The data from Subject 1 did not conform with this prediction and hence do not support the conditioned reinforcement account. Data from Subject 6 neither supported nor contradicted the account in this respect.

7.2.2 The Discrimination Difficulty Theory

Bandura's (Bandura and Barab, 1971) discrimination hypothesis applied to the experiments reported here would predict that as the number of sessions of differential

reinforcement of S+ training trial imitation increased, the likelihood of subjects distinguishing between demonstrations of training and probe responses would increase with a resulting rapid decline in the frequency of S+ probe trial imitation. Some of the probe trial data from Subject 1 conform with this prediction and could be interpreted to support the discrimination difficulty theory. However interpretation is complicated by the association between loss of S+ probe trial imitation and the introduction of training trial contingency reversals.

An additional interpretation difficulty arises from the absence of concurrent procedures for measuring subject's ability to distinguish between the training and probe sets of responses other than the dependent variables - frequency of S+ training and probe trial imitation - which comprise the results to be explained. For this reason, the data cannot be used to argue that Subject 1 was unable to distinguish between the two sets of responses before the decreases in S+ probe trial imitation occurred or that these decreases occurred as a result of development of ability to distinguish the two sets of responses. It seems appropriate to interpret these results in relation to research reported by Steinman (Steinman, 1970a, 1970b; Steinman and Boyce, 1971). He reported that subjects who had demonstrated their ability to discriminate between training and probe sets of responses continued to exhibit generalised imitation under the usual conditions for generalised imitation experiments. Hence for logical and empirical reasons the data reported here can provide only

inferential support for the discrimination difficulty theory.

Data from Subject 6 during the instruction not to imitate unreinforced imitations condition may be interpreted to provide inferential support for Steinman's view that subjects may continue to display generalised imitation even when they are able to distinguish between the training and probe sets of responses. A feature which weakens interpretation of this data was that the discrimination (between training and probe responses) test was conducted following the last session in which generalised imitation was demonstrated. However the delay was only about five minutes. It seems implausible that the differential reduction of S+ probe trial imitation would have occurred in response to instruction if the subject had not already acquired the ability to distinguish between the two sets of responses. The data is considered to provide inferential support against the discrimination difficulty theory.

7.2.3 Stimulus Control Theories

Steinman's (Steinman, 1970a, 1970b; Steinman and Boyce, 1971) view that emission of unreinforced imitations is controlled by social setting factors including implicit instructional effects carries the implication that it should be difficult to establish a discrimination involving imitation and non-imitation of the same response demonstrations on S+ and S- trials respectively. This view was supported by the fact that stable stimulus control of imitation emission was not established with four of the

five retarded subjects. However no test was conducted to determine these subject's ability to acquire a go-no go discrimination involving a number of non-imitative responses. Hence the difficulty in establishing stimulus control of imitation may not have been specific to imitation and may have reflected the action of variables other than those postulated in Steinman's hypothesis.

The data from Subjects 1 and 6 oppose any strong statement of Steinman's views. That is they do not support the view that social setting and/or instructional variables will necessarily have stronger effects than experimenter controlled contingencies. However, if the view was taken that Steinman's hypothesised social setting and/or instructional controlling effects result from pre-experimental learning according to an operant paradigm then the data may be interpreted to support a less situation (generalised imitation experiments) specific version of his views. If such control results from operant learning experiences then presumably appropriate contingencies might establish control by other stimuli (e.g. S+ and S-) which are directly manipulable by the experimenter.

Martin, J. (1971) argued that generalised imitation is a special case of generalised instruction following. He showed that antecedent verbal instructions controlled emission (or non-emission) of training and probe trial imitations in congruence with the usual effect of the contingency in which the instruction was included even

when the usual meaning of the instruction was incongruent with the contingency. For example, training and probe trial response demonstrations anteceded by "Don't do this" were imitated when training trial imitations were reinforced (Martin, J., 1972). A logical extension of his theory based on the results he has reported would predict that emission of imitation on training and probe trials may similarly come to be controlled by non-verbal stimuli if these were included as an antecedent in a differential reinforcement contingency.

The results reported here support this stimulus control account of generalised imitation. With Subjects 1 and 6, once stimulus control of the first few topographically different imitations had been established, almost every new training and probe response demonstration introduced was imitated on the first S+ but not on the first S- trial. The S+ may be conceptualised as a non-verbal instruction to imitate. In Experiments' 2 (prior to the contingency reversal) and 4 this instructional stimulus control of unreinforced as well as reinforced imitation was maintained. The results of the contingency reversals in Experiments' 3 and 4 showed that where this stimulus control of probe trial imitations was maintained, this was dependent on the inclusion of the same stimulus (S+) as an antecedent in the differential reinforcement contingency for S+ training trial imitations. It seemed that this inclusion of the S+ in the contingency was a necessary but not sufficient condition for stimulus control of generalised imitation.

7.3 RESPONSE CLASS AND STIMULUS CONTROL

7.3.1 Gewirtz's Account of Generalised Imitation

Gewirtz's account of generalised imitation (Gewirtz, 1969, 1971; Gewirtz and Stingle, 1968) has been categorized in Chapter 2 as a discrimination difficulty theory because it emphasises the role of intermittent reinforcement in decreasing the likelihood of discrimination between reinforced and unreinforced imitations. He has however conceptualised generalised imitation in terms of response class and has briefly discussed the possible role of stimuli other than the to-be-imitated response in controlling the emission of imitative behaviour. Hence his account serves as a useful starting point for considering a conceptualisation of generalised imitation in these terms.

Gewirtz considers that the first matching responses may occur by chance, through direct training, or in response to the same cues which occasion the model's behaviour. These matching responses are strengthened and maintained by direct extrinsic reinforcement. From this develops an imitative response class continuing topographically diverse by functionally equivalent matching responses maintained by intermittent reinforcement. An analogy is drawn between the variety of imitation topographies and the response variants which are members of a simpler response class such as bar-pressing. The importance of topographical differences is minimised while the importance of membership of the imitative response class as functionally

defined by reinforcing agents is emphasised. New imitations are routinely added to the class by virtue of their correspondence with the defining properties of the class. The argument continues that because the class members have diverse topographies and are intermittently reinforced discrimination between reinforced and unreinforced imitations is unlikely to occur. Hence new imitations which are never directly reinforced may be acquired and maintained.

So far then generalised imitation involves an imitation response class the members of which are individually controlled by stimuli comprising the response demonstrations which they match. He does not however completely neglect the notion that imitation may be controlled by stimuli other than the to-be-imitated response. He suggests that in real life the imitation behavioural unit usually includes a discriminative occasion indicating that imitation is likely to be reinforced (Gewirtz, 1969; Gewirtz and Stingle, 1968). More recently, (Gewirtz, 1971) he has suggested that imitation may come under a complex type of conditional stimulus control involving cues from both the modelled response and contextual cues indicating that imitation will lead to reinforcement.

Though this account is similar in many respects to the one offered in this thesis, the lack of emphasis on the role of stimulus control seems to leave the account of some aspects of generalised imitation inadequate. First, the theory does not really explain the mechanism of

addition of new imitations to the response class and notably offers no account of one trial acquisition. Second, the account of maintained unreinforced imitation by virtue of membership of the response class seems tautologous. Moreover this "explanation" in terms of discrimination difficulty is not empirically supported (Steinman, 1970a, 1970b; Steinman and Boyce, 1971). Third, the explanation of response class membership simply on the basis of a functional definition by the reinforcing agent and the oversimplified analogy between diverse imitation topographies and variants of a bar-pressing response seems inadequate. In this writer's view these difficulties are reduced by a more detailed consideration of the role of control by antecedent stimuli in functionally defining the imitative response class.

7.3.2 Defining a Response Class

A response class may be defined by the result of either logical or functional analysis. The resulting definitions may often, but not necessarily, be the same in effect.

Becker, Engelmann, and Thomas (1971) provide a definition based on logical analysis of an "operation" a term they use interchangeably with the term response class. The response class is logically defined by the set of characteristics shared by a set of responses which is not shared with responses of other response classes from which the class is to be differentiated. Logical analysis provides a procedural definition which specifies the

consequences for a variety of responses which is appropriate for the purpose of designing training procedures.

In the case of generalised imitation experiments, usually two non-exhaustive subclasses are procedurally defined. Namely, a training set of imitations which will be reinforced and a probe set of imitations which will never be reinforced are defined. Members of each subclass are specified by topographical description. In essence the training set is defined by the shared characteristic that the experimenter reinforces its members since there are no other shared characteristics not also shared by members of the probe set. In many generalised imitation experiments (e.g., Baer et al., 1967) when the emission of members of the subclass of imitations defined by experimenter controlled reinforcement is increased the emission of members of the other subclass is also increased. This type of interaction between behaviours is known as "response induction" (Millenson, 1967) and is directly related to the definition of a response class in terms of functional analysis.

Peterson (1968b) considers the concept of a functionally defined response class to be a descriptive one. He argues that the response class may be seen as consisting of a number of single responses which may be topographically similar or dissimilar. The essential feature of the functionally defined response class is that its members have the same relationship to common controlling stimuli which may have an eliciting, discriminative or reinforcing function. That is, responses may be

identified as members of a response class if a change in the appropriate controlling stimulus in relation to other responses results in congruent frequency changes for the responses in question, even though they did not enter into a contingent relationship with the changed stimulus. Consistent with this emphasis on the importance of stimulus functions, Berkowitz (1969) argues that the responses in the functional response class are defined by the stimuli which control them.

7.3.3 The Locus of Control in a Functional Response Class

In the simplest case the frequency of members of a response class is directly controlled by reinforcing stimuli. That is when members of one set of responses are reinforced, members of another set also occur more frequently even though they are not reinforced, and the frequency of responses of both sets decrease when reinforcement is discontinued. In this case differences in response topography are often small and the response variants may often be described in terms of values on one or more continuous dimensions. Apart from consideration of the setting in which the behaviour occurs and is reinforced, little emphasis is placed on the possibility of control by antecedent stimuli in the conceptualisation of the response class.

The phenomenom described above is usually referred as response induction (Millenson, 1967) or response generalisation (Reynolds, 1968). The term generalised imitation may be derived from the latter term. In the

following discussion it will be argued that conceptualisation of generalised imitation and the imitative response class in terms of response generalisation alone is incomplete.

A second more complex description of response class organisation may be given in terms of control by antecedent stimuli with a discriminative function. This stimulus control will in turn be dependent on inclusion of the antecedent stimulus in the differential reinforcement contingency for at least one set of responses. The antecedent stimuli may be relatively constant, vary along one or more dimensions, or be quite different for different members of the response class. The first and the third case appear to be relevant to an analysis of the imitation response class.

First consider the case where different responses are controlled by different stimuli which are equivalent in that each occasions a member of the response class. It may at first sight seem that member responses of the imitation response class are controlled solely by the topography of the stimulus (response demonstration) which the response matches. In this analysis then, the potential source of control over the emission of members of the response class as a whole by stimuli which are consistently present from trial to trial is disregarded.

Such a group of stimuli controlling members of the same response class has been called a disjunctive stimulus class (Millenson, 1967). A pedestrian traffic signal showing "Don't cross", a vehicular traffic signal showing a red light, a compulsory stop and a traffic

officer with one hand raised are examples of members of a disjunctive stimulus class controlling stopping behaviour. In the early stages of development of an imitative repertoire this type of organisation may occur.

However stimulus control by members of a disjunctive stimulus class has an important limitation. Each individual stimulus can only acquire control through inclusion in a three term differential reinforcement contingency. Since each new stimulus has no properties in common with previously included stimuli, it would be unlikely to occasion a member of the response class on the first trial it was presented. Hence any account which considers only the controlling relationship between each response demonstration and its matching imitation and ignores the potential controlling effects of stimuli common to trials for different imitations cannot account for one trial acquisition of new imitations. The analysis in terms of control by a disjunctive class of stimuli fails to account for the most important aspect of the imitation response class, namely that it comprises a generative repertoire.

Now consider the case where members of the response class are controlled by relatively constant stimuli. In most generalised imitation experiments (e.g. Baer et al., 1967) only S+ trials are presented. The functional analysis to determine the locus of control of the reinforced and unreinforced sets of imitation responses is usually conducted using an ABAB design involving alternating phases of reinforcement and extinction or DRO procedures applied to imitations of the training set of response

demonstrations. A simple interpretation of the results (co-variation in the frequency of imitations of training and probe response demonstrations) may be taken to indicate a simple reinforcement control situation. This is because the postulated underlying stimulus control of both training and probe trial imitations by common stimuli is dependent on the inclusion of these stimuli as antecedents in the differential reinforcement contingency for one of the sets (training trial) of imitations. That is the experimental design is not able to show whether or not stimulis control is involved.

In the research reported here both S+ and S- trials were presented for the set (training) of imitations which were to be differentially reinforced on S+ training trials and S+ and S- trials were presented for the unreinforced probe set of imitations. The presentation of S- trials was a control procedure to enable a separation of stimulus control from simple reinforcement control effects. The functional analysis to determine the locus of control of acquisition and maintenance of members of the unreinforced set of imitations was conducted by changing the antecedent stimulus in the differential reinforcement contingency for S+ training trial imitations. A discrimination reversal procedure was used so that the reinforcement became contingent on the emission of members of the training set of imitations following the stimulus which had previously been the S-. This procedure made it possible to show that acquisition of new imitations was better described in terms of stimulus control than response generalisation. In almost every case

demonstrations of new responses were first imitated on S+ trials. The procedure also made it possible to show that maintenance of unreinforced imitation (when it occurred) was best accounted for in terms of control by stimuli which were included as antecedents in the differential reinforcement contingency for S+ training trial imitations.

In the experiments reported here the S+ stimulus was common to S+ training trials for reinforced imitations and S+ probe trials for unreinforced imitations by design. In the more usual type of generalised imitation experiment there is no manipulation of antecedent stimuli. It may seem that there are no stimuli shared by training and probe trials so that generalised imitation in these experiments cannot be accounted for in terms of stimulus control. However, in most generalised imitation experiments there are many stimuli which are present on both training and probe trials. The behaviour of conducting an imitation trial and demonstrating the required response is in many ways distinctively different from other behaviours emitted by the experimenter. He usually waits till the subject's attention (often eye contact) is obtained, often uses verbal instructions, demonstrates a behaviour which may be unusual or out of its usual context, and then waits for a standard interval to provide the opportunity to imitate. Hence the general finding that unreinforced imitations are members of an imitative response class (see Chapter 1) may well reflect stimulus control by one or more of these "coincidental" stimuli (Burgess et al., 1970) or trials

correlated antecedent stimuli which are not an inherent part of the demonstrated behaviour.

However in the procedure reported here, presentation of the S+ and S- antecedents for reinforced and unreinforced training trial imitations was not correlated with the presence of absence of these coincidental stimuli. That is, the coincidental stimuli would have equally often been antecedents for reinforced (S+ training trial) and unreinforced (S- training trial) imitations of training response demonstrations and hence unlikely to acquire discriminative control of either training or probe trial imitations.

7.4 GENERALISED IMITATION AND MULTIPLE STIMULUS CONTROL

7.4.1 Instructional and Dimensional Controlling Stimuli

Goldiamond's (1966) analysis of multiple stimulus control of the discriminated operant suggests a way of conceptualising generalised imitation in terms which enable it to be understood in relation to the broader perspective of descriptions of other types of discriminative performance. He argues that in any experiment involving a discriminative performance, whether the experiment is considered to be examining learning, discrimination, perception or concept formation, and whether the subjects are human or non-human, the subjects' respond or come to respond to what are in a sense experimenter instructions. In experiments using human subjects the experimenter may use verbal instructions which "telescope a long history of training

which the training procedures used with animals often make explicit". (Goldiamond, 1966, p.185). Where verbal instructions are not used the subjects' behaviour may come to be controlled by other stimuli having the same effect. The point he makes is that verbal instructions are in more general terms discriminative stimuli. The difference between verbal instructions and other types of discriminative stimuli is that where the subject has experienced the appropriate contingencies the required behaviour may immediately occur in response to verbal instructions whereas when they are not used the appropriate instructional control is established during the course of the experiment.

He maintains that the discriminated operant is jointly controlled by discriminative stimuli which he calls "instructional discriminative stimuli" and "dimensional discriminative stimuli". The instructional stimuli restrict the range of stimuli controlling the subjects' behaviour and the response alternatives to these stimuli. The dimensional stimuli are those which are presented and which the subject is to respond to in some fashion specified by the instructional stimuli. Both types of stimuli are discriminative and acquire their controlling properties as a result of their presence or absence being systematically related to differential response consequences, either before or during the experiment. Where members of a response class are jointly controlled by instructional and dimensional stimuli, reinforcement would be contingent on the emission of the appropriate response in the presence of both stimuli.

An important feature of Goldiamond's instructional stimulus control notion is its utility for providing an account of generative repertoires in terms of relatively well established behaviour principles. When instructional stimulus control of members of a response class has been well established the subject may be able to respond appropriately to new dimensional stimuli on the first presentation so long as the instructional stimulus was also present. The subject would appear to be responding to a rule since the new dimensional stimulus would not have been included in the contingencies which established the instructional stimulus control. Though the controlling relationship between the instructional discriminative stimulus and the members of the response class will initially have been "contingency-shaped", at the stage of training where new dimensional stimuli are appropriately responded to on the first presentation only in the presence of the "instructional" stimulus the repertoire may be described as "rule-governed" (Skinner, 1969).

In situations where instructional stimuli are presented in a stimulus compound which may also include a dimensional stimulus (whether experimenter planned or not), the instructional stimulus controlled repertoire provides an example of abstraction. That is, a type of stimulus control exists such that members of a response class have been "brought under the control of a single property or a special combination of properties of a stimulus while being freed from the control of all other properties". (Skinner, 1953, p.134). It may also be

possible to conceptualise phenomena described in terms of learning set formation (Harlow, 1949; 1959) in terms of acquisition of control by instructional stimuli. Organisms of several species show accelerated acquisition of the appropriate choice response over a series of otherwise unrelated two choice problems. In this case the appropriate repertoire (make a choice and if no food is found make the alternative choice on the next trial) may be thought of as instructionally controlled by stimuli comprising the entire problem solving situation.

It should be noted that the instructional stimulus is seen as controlling a class of responses which may not all have the same topography. In practise the controlling relation will become evident only when several instances of instructional stimulus control (or control by an abstracted stimulus) are observed. Furthermore the explicit separation of instructional from dimensional stimulus control will only be observed in experiments which follow the conditional discrimination paradigm.

Sherman, Saunders, and Brigham (1970) reported research on matching-to-sample which partially illustrates the response class organisation discussed here. Preschool children were trained to choose stimuli which matched or did not match three different sample stimuli. A fourth sample stimulus was used as a probe to evaluate transfer effects. When children were trained to match the three sample stimuli they also matched the probe sample though these responses were never reinforced. When the same children were trained to mismatch the same three sample

stimuli they also mismatched the probe sample. An interpretation in terms of multiple stimulus control would suggest that presentation of the sample stimulus was a joint presentation of an instructional and a dimensional discriminative stimulus. The instructional properties of the stimulus may be inferred from the matching or mismatching choice response to the probe stimulus in congruence with the contingencies in effect for the three training sample stimuli. Abstraction has occurred since the instructional effect is not dependent on the unique properties of the stimulus presented. The unique properties comprise the dimensional stimulus which is matched or mismatched. However the experiment does not make the instructional effects explicit. If subjects were trained to match in the presence of one stimulus and mismatch in the presence of another stimulus within sessions, then the instructional stimulus control could potentially be demonstrated by repeated presentations of the probe sample stimulus in the presence of the match and the mismatch stimulus.

7.4.2 Instructional Stimulus Control of the Imitation Response Class

It is suggested that when generalised imitation is demonstrated the emission of imitations is jointly controlled by instructional and dimensional discriminative stimuli. Where generalised imitation is demonstrated it would seem that topographically different imitative responses are in turn members of an imitation response class which owes its existence to, and can be defined in terms of, control by

a discriminative stimulus (or stimuli) with an instructional function which is a shared antecedent for training and probe trials. The dimensional discriminative stimuli consist of the unique properties of each of the topographically different response demonstrations.

In the experiments reported here the conditional discrimination paradigm was used so that the separate existence of instructional and dimensional stimulus control could be demonstrated. Instructional stimulus control of members of the imitation response class was considered to be demonstrated when imitations were frequently emitted on S+ training and S+ probe trials while being infrequently emitted on S- training and S- probe trials even though the same responses were demonstrated on S+ and S- trials. That is the experimental S+ and S- acquired the same instructional controlling effects as the words "Do this" and "Don't do this" respectively. When S+ trial imitation was equiprobable for different response demonstrations and for the training and probe sets of response demonstrations, this was considered to demonstrate that emission of members of the imitation response class had been freed from control by the unique properties of the topographically different response demonstrations. That is abstraction had occurred. Instructional stimulus control was also considered to be demonstrated by the absence of imitation of the experimenter's behaviours between trials.

The unique properties of the different response demonstrations are considered to correspond with Goldiamond's dimensional discriminative stimuli in the sense that each

can be assigned a value at either end of an arbitrary presence-absence stimulus dimension. Dimensional stimulus control was considered to be demonstrated by the high frequency of matching responses and the near zero frequency of emission of experimentally trained responses in the absence of the appropriate response demonstration. To simplify the conceptualisation, instructional stimuli control performance as opposed to non-performance of any member of the imitation response class, whereas dimensional stimuli control the topography of the response providing that the appropriate instructional stimulus is present.

Martin, J., (1971a, 1971b) and Steinman (1970a, 1970b) have offered accounts of generalised imitation which are in some respects similar to the application of Goldiamond's analysis of multiple stimulus control of the discriminated operant discussed here. They are both accounts in terms of stimulus control. Martin considers that generalised imitation is a special case of generalised instruction following while Steinman considers it to be the result of implicit instructions. These notions are not completely equivalent to Goldiamond's more general notion of instructional stimulus control but seem to be specific examples of instructional stimulus control. Steinman (1970a, 1970b) and Steinman and Boyce (1971) have also argued that implicit instructional effects to some extent have their origin in social setting stimuli which are present throughout the experimental session rather than occurring in a purely antecedent relationship to imitations. This type of stimuli and their function also seem consistent

with the notion of control by instructional discriminative stimuli. Research has already been cited which shows that experimenter presence immediately following a response demonstration (normally a constant stimulus in generalised imitation experiments) may control emission of unreinforced imitations (Peterson and Whitehurst, 1971; Peterson et al., 1971).

7.4.3 Multiple Stimulus Control when Generalised Imitation was not Maintained

So far, an account has been offered of what may occur when generalised imitation is obtained. It seems appropriate to attempt an analysis in terms of stimulus control of what may occur when generalised imitation is not maintained. A loss of S+ probe trial imitation occurred in Experiments 2 and 3 (see Figures 10 and 11) and the following discussion will be related to these results.

The emission of S+ probe trial imitations was initially controlled by the experimental stimulus (S+). The loss of S+ probe trial imitation implies at least a partial shift in the locus of stimulus control. Neither the members of the training or probe sets of response demonstrations exclusively shared any stimulus properties (though members of the probe set shared their inclusion as antecedent stimuli in an extinction contingency). It follows that stimulus control of emission (or of non-emission) of imitations was in part transferred to the unique stimulus properties of individual response demonstrations. The question that arises is whether imitation

came to be partly controlled by the stimulus topographies of training response demonstrations or whether non-imitation came to be partly controlled by the stimulus topographies of probe response demonstrations, or whether both processes occurred.

The relevant results from Experiments' 2 and 3 and from the informal investigation reported in the introduction to Experiment 3 will be briefly summarised. Imitation frequently occurred on S+ training trials and on S+ probe trials when the probe response demonstrated was relatively novel. Imitation infrequently occurred on S- training and probe trials or on S+ probe trials when the probe response had previously been demonstrated several times.

The imitation of relatively novel response demonstrations on S+ but not on S- trials suggests that the experimental stimuli were still the main loci of instructional control of imitation and non-imitation but that imitation of probe responses which had previously been demonstrated in several sessions had been excluded from this instructional control. That is stimulus control of non-imitation of these probe response demonstrations now had its locus in the stimulus properties of the individual probe response demonstrations.

7.5 CONCLUSIONAL COMMENTS

7.5.1 Experimental Design

Instructional control effects occurring in an experiment may have their origin in planned or unplanned

contingencies operating during the experiment or, if appropriate discriminative stimuli are present, in the subjects pre-experiment social learning history. Steinman argues that "the continued imitation of nonreinforced responses, is largely a function of the particular procedures typically used to study the effect" (Steinman, 1970a, p.98) and that "the generalized imitation effect, when obtained by single presentation discrimination procedures, can result from social contingencies that the procedures bring into operation". (Steinman and Boyce, 1971, p.264). His view is supported by several studies (Peterson et al., 1971; Peterson and Whitehurst, 1971; Steinman, 1970a, 1970b; Steinman and Boyce, 1971).

While this view can provide an account of the occurrence of generalised imitation in the experiments cited above, it provides no account of the acquisition and organisation of the repertoire which may be activated by instructions and social setting stimuli. This deficit may be largely a result of the intrinsic limitations regarding what type of information may be obtained with the type of experimental design and procedures used in the studies. For this reason the experimental design and procedures used in the studies reported here differed from the majority of those cited.

The most important feature of the experimental design was the use of the conditional discrimination paradigm combined with a correction procedure for "inappriate" responses to establish the basic repertoire. This made it possible to bring imitation (as opposed to

non-imitation) under the discriminative control of experimental antecedent stimuli with a known history in relation to imitation and to remove imitation from the control of unspecified influences possibly established before the experiment. A related feature designed to further minimise pre-experimentally acquired influences was the non-use of "Do this" instructions on all trials.

The second feature of the experiment was the presentation of both S+ and S- probe trials. The S- probe trials provided a concurrent control for the effect of any general implicit instruction to imitate or any other social setting influences not specific to the experimental stimuli included in the training trials contingencies.

The third notable feature of the design was the use of a discrimination reversal procedure for the functional analysis. This feature made it possible to demonstrate that generalised imitation, when it occurred, was a stimulus controlled performance and that this control was dependent on the inclusion of the controlling stimulus in the differential reinforcement contingency for S+ training trial imitations. The extinction and DRO procedures used in most generalised imitation experiments for demonstrating reinforcement control are not adequate for the purpose of demonstrating the latter relationship.

The basic experimental design used in generalised imitation experiments is well illustrated by the work of Baer et al., (1967). Subjects were first trained to imitate on S+ training trials. All trials were preceded by the instruction "Do this" and no S- training trials

were presented. When a variety of response demonstrations was reliably imitated and one trial acquisition of novel imitations had begun to occur, interspersed S+ probe trials preceded by "Do this" were introduced. No S- probe trials were presented. A DRO procedure was used to demonstrate reinforcement control of S+ training and never reinforced S+ probe trial imitation.

This experimental design was well suited for the intended purpose of demonstrating the phenomenon of generalised imitation and its control by reinforcement. It should be noted though that some researchers (e.g. Burgess et al., 1970) have been unable to demonstrate reinforcement control of generalised imitation using extinction or DRO procedures alone. Under these circumstances it becomes difficult to determine to what extent generalised imitation occurred as a result of the experimental training procedures since the possibility that the procedures merely activated pre-experimental acquired social-instructional effects cannot be excluded. However the greatest problem resulting from the use of this design is that even when reinforcement control can be demonstrated, there is no way of evaluating the possible role of antecedent stimuli which occur on both training (reinforced) and probe (unreinforced) trials and which are not specific to any particular response demonstrations, in mediating the effect of reinforcement of training trial imitations on the emission of probe trial imitations.

Some researchers have used procedures intended to nullify or minimise social-instructional effects. Steinman

(1970b) attempted to train six normal six to nine year old children to emit only reinforced (training trial) imitations. The two sets of responses for reinforced and unreinforced imitations were demonstrated by different models. Trials for unreinforced imitations were interspersed among those for reinforced imitations, a non-correction procedure was used, and both models preceded response demonstrations with the instruction "Do this". Under single-presentation trial conditions (successive stimulus presentation discrimination procedure) all subjects continued to emit both reinforced and unreinforced imitations. In phase B of the same experiment blocks of choice-presentation trials (simultaneous stimulus presentation discrimination procedure) were conducted during sessions which also contained single-presentation trials. On each choice-presentation trial one training and one probe response was demonstrated. Probe responses were paired equally often with each training response and the order of demonstration was balanced within blocks. This provided a concurrent control procedure for the effect of social-instructional variables which was conceptualised as over-riding the expected effect of the differential reinforcement contingency. Five subjects differentially emitted reinforced imitations on choice trials while continuing to emit both reinforced and unreinforced imitations (generalised imitation) on single-presentation trials. Steinman (1970a) obtained similar results even when training and probe responses were demonstrated by the same model.

Steinman (1970a, 1970b) argues that the choice-

presentation procedure allows subjects to avoid emitting unreinforced imitations without disobeying an adults implicit or explicit instruction to imitate. This procedure made it possible to demonstrate that subjects could discriminate between models and/or sets of response topographies which set the occasion for reinforced and unreinforced imitations during sessions where generalised imitation was concurrently demonstrated on single-presentation trials. Hence this particular design enabled evidence to be obtained supporting the view that emission of unreinforced imitations continues as a result of the presence of social-instructional stimuli which had probably acquired a controlling influence before the experiment. Nevertheless the experimental design was limited in one respect which will be developed following examination of the experimental design of another relevant study.

Bandura and Barab (1971) took considerable care to minimise potential sources of social-instructional control in their experiment. No verbal instructions were used. The models had no contact with subjects outside the experimental room and during the experiment made no eye contact or conversation except briefly during reinforcer delivery. No physical prompts were used to establish imitation. Instead non-imitating subjects were prompted by allowing them to observe peer models whose imitations were reinforced. Social pressure to imitate was further reduced by providing only a three second opportunity to imitate period and using a non-correction procedure. Imitations of training responses were reinforced till they occurred frequently.

A second model who demonstrated probe responses in blocks of trials was then introduced. Group data showed continued emission of reinforced imitations but a significantly lower frequency of emission of unreinforced imitations ($p < .005$) which decreased further over sessions ($p < .001$). Similar results were obtained in the second phase of the experiment where the same model demonstrated both the training and probe responses in separate blocks of trials.

In this experiment where social-instructional pressures were minimised the non-occurrence of generalised imitation was demonstrated. In this respect the procedures were similar in effect to Steinman's choice-presentation procedure which nullified the hypothesised social-instructional variables influencing the performance of unreinforced imitations. However a weakness in the experimental design used in the Bandura and Barab study was the absence of any control procedure to make it possible to show that the non-occurrence of generalised imitation was related to the procedures minimising social-instructional pressures.

Both Bandura and Steinman argue in the papers cited above, that generalised imitation is the result of use of experimental designs which do not include proper controls for the effect of some variable(s) which are not experimenter planned inclusions in the experiment. Their view is that coercive or social-instructional features are inherent in the typical generalised imitation experimental paradigm and the experimental designs they employ appear to reflect this orientation. Further discussion of appropriate experimental designs for the study of generalised imitation

may be usefully centred around two related points which emerge from a consideration of the views of Bandura and Steinman. The first point is that the experimental design used in a generalised imitation experiment will largely determine what features of generalised imitation can be studied and what findings it will be possible to obtain. The second point is that even if generalised imitation can be satisfactorily explained in terms of social-instructional controlling effects established before or during the experiment and which appear to operate in the typical generalised imitation experiment, this is of itself an important phenomenom which in turn could appropriately be investigated rather than offered as an "explanation". It may now be more useful for generalised imitation research to employ experimental designs which make it possible to investigate the nature of social-instructional control in an experimentally controlled manner rather than simply investigating the effects of a repertoire probably acquired through natural contingencies experienced before the experiment. In particular the use of experimental designs which permit investigation of the nature of the contingencies which produce strong enough instructional control so that children will continue to emit unreinforced imitations, and of the organisation of the instruction following or generalised imitation repertoire in relation to controlling stimuli may warrant greater research attention.

An experimental design based on the conditional discrimination paradigm is well suited to the purpose of

studying the development of instructional control and the role of antecedent stimuli in discriminatively controlling one trial acquisition of novel imitations. Williams' (1971) research provides an example of the use of this paradigm which differs in some respects from the procedures used in the studies reported in this thesis. During the discrimination (between S+ and S-) training phase the same training responses were demonstrated on S+ and S- training trials. The "Do this" instruction was used only on S+ training trials. When differential imitation of S+ training trial demonstrations had been established the instruction was faded in on S- training trials and was subsequently used on all trials. Instead of using a correction procedure to reduce the frequency of imitation on S- training trials, subjects were physically restrained on these trials till the discrimination was established. The restraint procedure was then faded out. Under these conditions the emission of imitations was brought under the control of the experimental antecedent stimulus (S+) and freed from control by the instruction "Do this". Hence use of the instruction of both S+ and S- training trials combined with the discrimination training procedures provided a control for pre-experimentally acquired stimulus control effects which could contaminate the experimentally developed repertoire. When S+ and S- probe trials were introduced it was found that imitation of probe responses was also discriminatively controlled by the experimenter arranged antecedent stimulus which had been included in the differential reinforcement

contingency for S+ training trial imitations. Williams also used a discrimination reversal procedure for the purpose of functional analysis of the relationship between the control exerted by the antecedent stimulus and the differential reinforcement contingency in which the stimulus was included.

Hence this experimental design, unlike those used in the typical generalised imitation experiment made it possible to demonstrate one way in which instructional stimulus control maybe developed. In addition it was possible to show with this design that the instructional control exerted by the antecedent stimulus was dependent on the experimenter arranged differential reinforcement contingency. The experimental designs discussed earlier in this section were limited in that while direct or inferential evidence of social-instructional influences could be obtained, the development and organisation of such control could not be investigated.

7.5.2 Limited Generality of the Results and Conclusions

Two aspects of stimulus control of generalised imitation were investigated. The results demonstrating the stimulus control involvement in one trial acquisition of novel imitations and the dependence of this stimulus control on the differential reinforcement contingency in which the controlling stimulus was included were replicated several times with one subject and repeated with a second subject. Hence considerable confidence may be held in the stimulus control account of this aspect of generalised

imitation for these subjects.

The results of the investigation of stimulus control involvement in the maintenance of unreinforced imitations were less clear. Where unreinforced imitation was maintained, this always occurred on S+ probe trials. Hence some confidence could be attached to the view that this was a stimulus control effect. Unfortunately the dependence of this stimulus control on inclusion of the stimulus as an antecedent in the differential reinforcement contingency for S+ training trial imitations could only be demonstrated under steady state conditions with one of the subjects. Nevertheless, the partial and/or temporary behavioural reversals which occurred on probe trials with the other subject were all consistent with the view that where unreinforced imitation was maintained this was a stimulus control phenomenon dependent on the inclusion of the controlling stimulus in the differential reinforcement contingency for S+ training trial imitations.

The generality of these results was considerably limited by the small number of subjects from which they were obtained and by the failure to establish even the prerequisite repertoire with four of the five retarded subjects. Any interpretation of the results of other generalised imitation experiments in terms of the instructional stimulus control account offered here is limited by the necessary differences in experimental design and procedures. Strictly, this account of what occurs in generalised imitation experiments only applies where generalised imitation does in fact occur and can only be

explicitly demonstrated in experiments using the conditional discrimination paradigm. In addition, the discriminative function of the experimental stimulus exerting instructional control can only be demonstrated when the relationship between the stimulus and the imitation contingent consequences is manipulated as in the discrimination reversal procedure. Only the research reported by Williams (1971) incorporated all these features. Consequently, it is only possible to assert that a mechanism has been demonstrated which may account for generalised imitation in other experiments.

In relation to childrens' imitative behaviour in their natural environments, the results of the experiments reported here suggest that once a basic imitative repertoire has been acquired, rapid or even one trial acquisition of novel imitations may occur as the result of influence by instructional discriminative stimuli. In addition the results suggest what type of contingencies might produce such stimulus control of imitation. The results do not of course provide any direct evidence that the same processes do occur in childrens' natural environments. Though it might be speculated that imitation is often controlled by stimuli which signal a high likelihood that an observed behaviour would be reinforced if imitated, such stimuli occurring in the natural environment might often be difficult to isolate and specify. However some evidence on this question has been reported by Bandura (1965a) who found that models whose response demonstrations were reinforced were more likely to be imitated by children

than were models who did not receive reinforcers. Similarly, Bandura, Ross, and Ross (1963) found that a model with social power (i.e. control of the reinforcers) was more often imitated than a model without social power. Naturalistic observation indicates that individuals frequently imitate other peoples' behaviour if it is being performed by a large group of people at the same time (e.g., looking up at an aeroplane or looking in a shop window). If the large number of people engaging in the same behaviour is taken to signal that the behaviour is being reinforced, then this would appear to lend support to the notion that imitation emission in the natural environment may be controlled by discriminative stimuli which are not specific to the behaviour observed in much the same way as the experimental stimulus (S+) did in the experiments reported here.

7.5.3 Implications for Research and Application

Current interest in the experimental analysis of generalised imitation has probably resulted from the imitially surprising finding that most subjects in generalised imitation experiments do not appear to discriminate between response demonstration topographies preceding reinforced imitations from those preceding unreinforced imitations. Some investigators have approached the problem by asking why the emission and non-emission of imitations does not come to be controlled by the stimulus topographies of the response demonstrations which consistently set the occasion for reinforcement and non-reinforcement respectively

(e.g. Bandura, 1969a, 1969b, 1971; Bandura and Barab, 1971). An alternative approach pursued in the studies reported here and by some other investigators (e.g. Peterson and Whitehurst, 1971; Steinman, 1970b) is to ask what antecedent stimuli do control the emission of both reinforced and unreinforced imitations. One advantage of the latter approach is that it avoids the problem of the tautologous "explanation" which is inherent in the former discrimination difficulty type of approach. A second advantage of the latter approach is that it seems more likely to lead to experimentally demonstrable control of the generalised imitation phenomenon rather than simply demonstrating circumstances where generalised imitation does not occur.

To some extent the notion that antecedent stimuli discriminatively control the emission of unreinforced imitations is trivial. Questions which might usefully be investigated are, what stimuli come to control emission of unreinforced imitations in generalised imitation experiments, what conditions lead to the establishment of stimulus control, and what conditions are required for stimulus control of unreinforced imitations to be maintained under steady state conditions. Investigators may find it useful to keep in mind Steinman's view (Steinman, 1970b) that two controlling systems are operative in generalised imitation experiments. It may be difficult to investigate stimulus control in relation to an experimenter arranged differential reinforcement contingency unless appropriate controls are employed to isolate the effect of the second

controlling system deriving from subjects learning history before the experiment and vice versa.

The general approach of using the conditional discrimination paradigm to investigate the occurrence of instructional discriminative stimulus control of generalised imitation may be of interest to researchers who wish to study the establishment and organisation of other generative repertoires. Such research might have practical implications for special education programmes developmentally retarded children. A generative repertoire comprises a response class where not all of the potential members of the class need to be directly established by training. In some cases it may in fact be impossible to exhaustively list the potential members. Imitation, matching-to-sample (considered to be an important pre-reading skill) and the ability to correctly emit all regular plural word endings after only learning a smaller set of examples are all examples of generative repertoires.

For many special educational tasks the establishment of a generative repertoire may have advantages. One advantage is that during the training of such a repertoire the rate of acquisition of successive new responses accelerates till eventually the one trial acquisition stage is reached. There is an obvious gain here in terms of teaching time. Once the generative repertoire has been shown to be established by the occurrence of appropriate responses to several new stimuli which have not previously been included in the training programme, the child is left equipped with a repertoire enabling it

to benefit from an increased variety of incidental learning experiences. As well the child may be presented with further learning materials related to the repertoire without requiring specific teaching to establish appropriate responses. An example of this would be teaching a child a general method of plussing all combinations of numerals from zero to nine so that any problem of this type could be solved. In terms of the account of the organisation of generative repertoires offered here, the + and the = signs could be considered to function as instructional discriminative stimuli while the particular numerals presented could be considered to be dimensional discriminative stimuli.

One specific use of a generative physical imitation repertoire, which may itself first need to be established by training, is that it makes it possible to prompt appropriate responses to other stimuli. An example of this is seen in training programmes designed to establish simple receptive language. Response demonstration is used to prompt the appropriate motor response to a verbal instruction. Another language development use of the properties of a generative repertoire occurs in programmes designed to train appropriate responses to an abstract property of a stimulus such as the words "in" or "under". Once the child has been trained to respond appropriately to an instruction such as "Put the (object) in the (container)" in connection with a variety of objects and containers the word "in" acquires instructional control of appropriate responses with other objects and containers

not included during the training phase, so long as the names for the objects and containers have previously been taught.

If generative repertoires or generalised response classes are acquired and organised on the basis of control by antecedent stimuli which acquire instructional properties then a more precise understanding of the necessary conditions for rapidly producing such control could have considerable socially valuable implications for applications with children requiring special education.

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APPENDIX

ADDITIONAL PROCEDURES USED TO ESTABLISH STIMULUS CONTROL OF IMITATIONS WITH SUBJECT 1

8.1 INTRODUCTION

When a response with no "incorrect" variant available (response number 3, nod yes) was introduced with Subject 1 early in Experiment 1, the separation of percent imitation on S+ and S- training trials previously established with response number 1 (raise left arm) could not be obtained (see Figure 5, parts b and c). The results shown in part b of Figure 5 reflected a performance where imitation occurred on S+ training trials but on S- trials an "incorrect" variant (raise right arm) was emitted which according to the criteria for imitation used here was not an imitation. It was considered desirable to establish a repertoire where behaviours similar to imitation were not emitted on S- trials to prevent any repetition of the abrubt loss of stimulus control obtained with the "nod yes" response.

8.2 METHOD AND RESULTS

The discrimination training procedure described in Experiment 1 was continued with some modifications and a response requiring a more "effortful" imitation was demonstrated to the subject. It was expected that this would reduce the frequency of imitation on the unreinforced S- training trials. However this manoeuvre also reduced the frequency of imitation on S+ training trials. For this reason a shaping procedure was used.

Initially S+ training trial imitations completed within 30 seconds following trial presentation were differentially reinforced. The imitation completion time criterion was then gradually reduced to the usual 10 seconds at a rate which enabled 60 to 100 percent of otherwise appropriate S+ training trial imitations to be reinforced (see Table 20).

The response "stand on chair" was chosen as an effortful response since Subject 1 was obese and not particularly agile. Following pilot trials the response specification was altered to require the subject to also replace both feet on the floor, as on S- training trials where imitation was not reinforced the subject often remained standing on the chair for up to 10 minutes if not told to get down. Another requirement prompted by pilot trial observations was that one foot be placed on the chair seat within 10 seconds following trial presentations. The adoption of this requirement made it possible to terminate trials where it was almost certain that an imitation meeting the imitation completion time criterion would not occur, before the subject had climbed on the chair. Though these criteria were in fact differential reinforcement criteria for S+ trial behaviour, the same criteria were used to judge whether behaviours emitted on S- training trials were imitative or non-imitative.

Physical guidance was required to occassion reinforceable S+ training trial imitations in the first training session (Session 44). Never-the-less by Session 48 percent imitation on S- training trials had only been reduced to a level about 5 percent below the 100 percent imitation obtained on S+ training trials (see Figure 15). Hence a "no hands" condition where the subject was not allowed to

TABLE 20

The sequence of changes of criteria for reinforcement of S+ training trial imitations during the use of additional procedures to establish stimulus control of imitations with Subject 1 in Experiment 1.

Sessions	Reinforcement Criteria	
	Completion Time Criteria	Topographical Criteria
44-48	30 sec	"HANDS". Subject must have placed one foot on the chair seat within 10 seconds of trial presentation, stood with both feet on the chair seat, and then replaced both feet on the floor. Subject was allowed to use her hands on the back of the chair to pull herself up.
49-50		"NO HANDS". As above except that the subject was not allowed to use her hands to pull herself up on to the chair.
51	28 sec	
52	26 sec	
53-55	20 sec	
56		"HANDS". As for sessions 44-48.
57-58	16 sec	
59-61	14 sec	
62-63	12 sec	
64-72	10 sec	

use her hands on the back of the chair to pull herself up was introduced to make the imitation even more effortful (see Table 20). This was followed by a large and rapid decrease in percent imitation on S- training trials and a somewhat smaller decrease on S+ training trials (see Figure 15).

Once stimulus control was established the imitation completion time criterion for differential reinforcement was gradually reduced (see Table 20). Over Sessions 49-72 the completion time of each S+ training trial imitation was recorded to enable the completion time criterion to be reduced at an appropriate rate. Figure 16 shows that the mean S+ trial imitation completion time initially decreased but then increased to a level above the imitation completion time criterion in the last two sessions of the "no hands" condition. In addition the Subject had been reluctant to enter the experimental room over the last three sessions of the "no hands" condition.

In Session 56 the "hands" condition where the subject was allowed to use her hands to pull herself up on to the chair was reintroduced. This was followed by a decrease in the mean S+ trial imitation completion time (see Figure 16) and an increase in the percentage of reinforceable S+ trial imitations (see Figure 15) and the Subject was no longer reluctant to enter the experimental room. Despite some increase in percent imitation on S- trials a degree of stimulus control was maintained as the imitation completion time criterion was further reduced. Percent imitation on S- trials was unstable for several sessions after the final

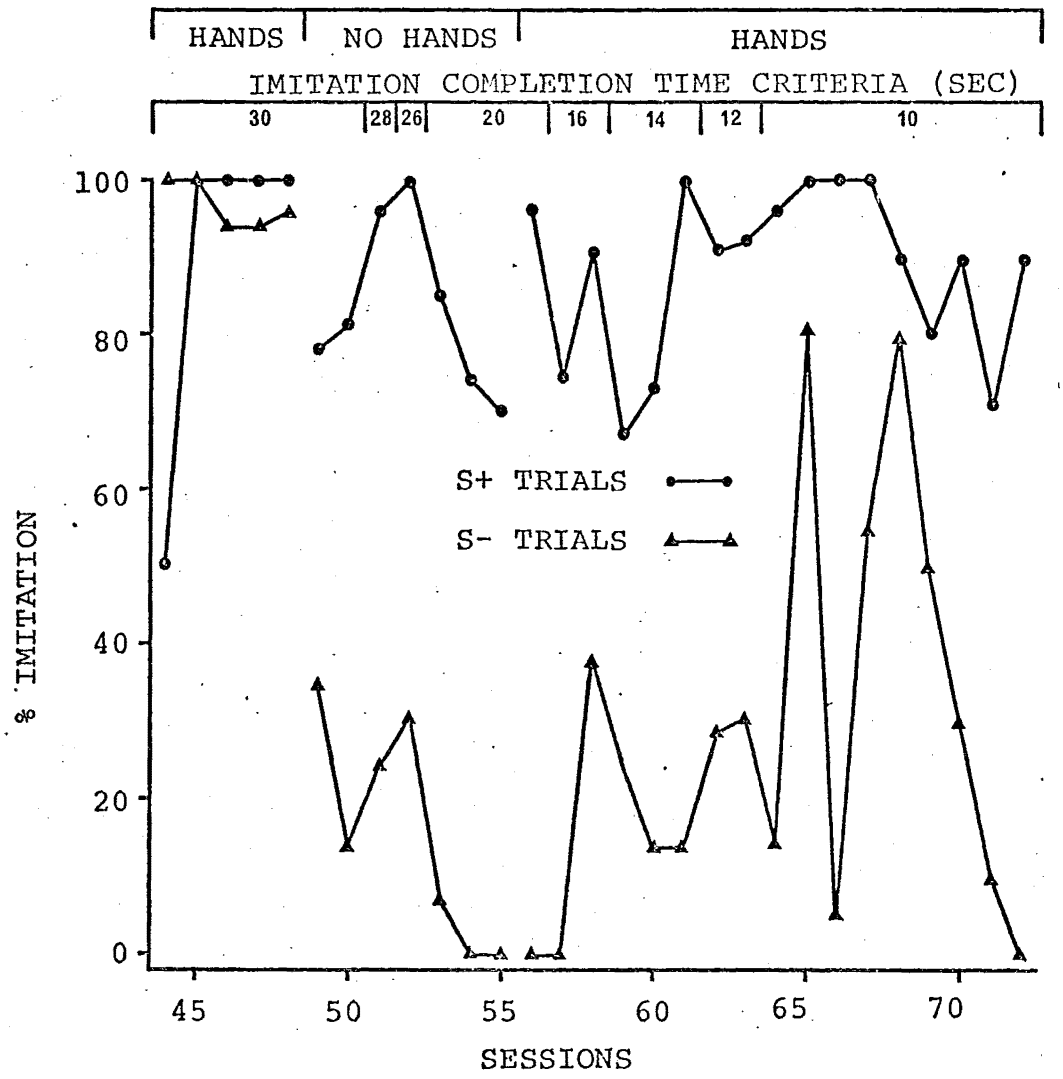

FIGURE 15 Percent imitation on S+ (imitations reinforced) and S- (imitations not reinforced) training trials during the use of additional procedures to establish stimulus control of imitations of response number 4 with Subject 1 in Experiment 1. Data points show the percentage of responses meeting the S+ training trial reinforcement criteria in effect at the time and so are not all equivalent measures of imitation. Table 20 shows the sequence of changes in reinforcement criteria over Sessions 44-72.

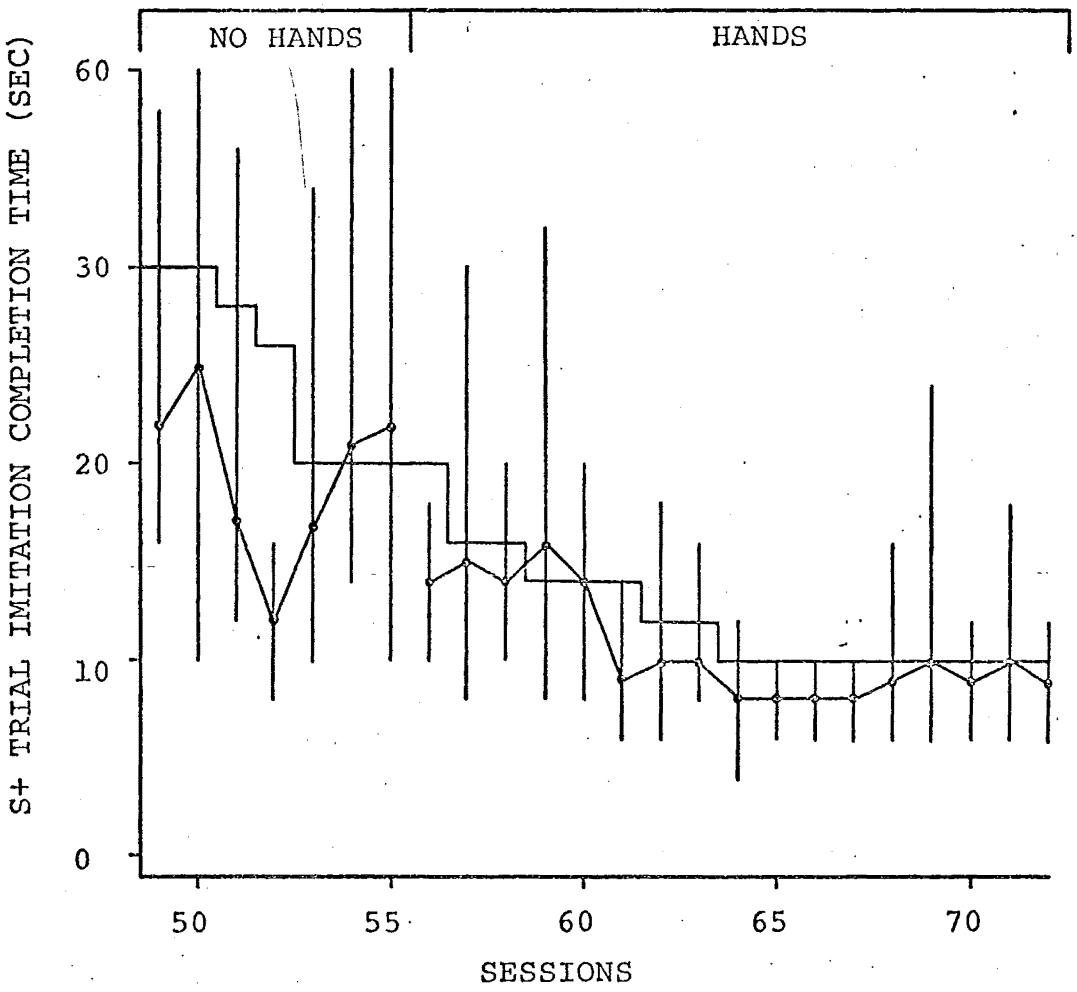

FIGURE 16 Means (connected dots) and ranges (vertical lines) of S+ trial imitation completion times over sessions where progressively shorter imitation completion times were differentially reinforced, for Subject 1 in Experiment 1. The completion time criteria for reinforcement are shown by the stepped horizontal line. Table 20 shows the sequence of changes in reinforcement criteria.

reduction of the completion time criterion to 10 seconds but by Session 72 appropriate stimulus control had been re-established.

To increase the likelihood that stimulus control would be maintained the next three responses introduced into discrimination training (responses numbered 5, 6 and 7 from Table 5) were selected on the grounds that no "incorrect" response similar to imitation was likely to occur and that the imitations would be sufficiently "effortful" to discourage imitation on S- trials. When stimulus control of imitations of responses numbered 4-7 had been established responses numbered 1-3 were re-introduced. Figure 10 (section h) shows that stimulus control was not disrupted. Moreover, the low percent imitation on S- training trials now reflected a performance where the subject did not make any attempt to produce responses similar to imitation. No further additional procedures were required to extend stimulus control over new imitations. The basic discrimination training procedure described in Experiment 1 was continued.